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A Survey of Athletic and Gymnastic Costumes Used by American Girls and Women

By Mabel Lee
Professor of Physical Education, University of Nebraska
(A Study Sponsored by the Publicity Committee, Women's Section, A. P. E. A.)

Introduction

THE Publicity Committee of the National Women's Athletic Section of the American Physical Education Association invited the writer to undertake for it this piece of work after considerable discussion had arisen concerning athletic costumes at the annual meeting of the Women's Division of the National Amateur Athletic Federation in New York City in January, 1929. A questionnaire was drawn up and submitted for criticism and suggestions to both the Publicity Committee, which was financing the expense of the survey, and the Women's Division of the National Amateur Athletic Federation. After many changes of the original a questionnaire was decided upon which seemed to cover fully the matters under discussion.

A mailing list of six hundred and fifty (650) organizations was drawn up including colleges, preparatory schools, normal schools, high schools, Y.W.C.A.'s, industrial organizations, and athletic clubs. A decided effort was made to reach industrial organizations and athletic clubs. Y.W.C.A.'s assisting in athletic programs for industrial groups were enlisted in the effort to organize a goodly mailing list. Firms handling athletic costumes, as well as sporting goods houses, were called upon for help in securing names and addresses of such groups. As certain of these organizations were reached they sent in names of others. Thanks to the splendid assistance of these people a fine list was prepared, a list quite thoroughly covering the country. Questionnaires were then sent to all groups on the list. As replies failed to come in, follow up letters were sent out but all efforts proved in vain. Work on the survey was held up for a considerable length of time in an effort to reach them. Only five organizations replied and as these five are closely grouped geographically it seemed best to give up all attempts at including industrial organizations and athletic clubs in this study. We are deeply indebted to the five organizations that did reply and are indeed sorry that their replies could not be included in this study.

Taking the ten groupings determined upon, a mailing list was prepared for each group so that every state in the Union was represented in each group so far as that was possible. Such a list gave us a field of ten different types of organizations from each of the forty-eight states. A forty-nine plus per cent (49+%) reply to the questionnaires was most gratifying, especially in view of the fact that the questionnaire was a long and tedious one. Not only did the replies pour in, but in many cases they came with lengthy letters attached, still further explaining and describing costumes. They came accompanied by drawings that must have taken much care and time. They came accompanied by photographs of all sizes and accompanied by snapshots with notes written on the back. They came with catalog "cut-outs," with notes written all around the margins. A number of supervisors wrote for extra copies of the questionnaires and one supervisor wrote for one for each high school in the city and followed up our reply by returning to us six questionnaires fully filled out in minute detail, even though each of the six high schools uses a different costume. Practically all of the questionnaires were completely filled out even though it was a very lengthy one. One person took the time and trouble to return the questionnaire entirely unanswered but accompanied by a note to the effect that the writer may have time to bother with such things but she was entirely too busy. Even this note added to the interest of the study. One reply was sent ashore by the pilot of a steamer and another from the sailing port as two persons, Europe bound and busy up to the last minute of sailing, took that last chance to send in their replies so that their organizations would be represented in this survey.

The great interest shown surely means that the subject of athletic costumes for girls and women is a very important one at this time. It is with a feeling of deep gratitude to all who so generously sent in replies that the results of this survey are now presented to the public.

Field Covered by the Survey

Number of states reached	48
Number of organizations to which the questionnaire was sent	650
Number of organizations replying	320

Ten types of groups are represented in the survey as follows:

1. 53 universities, representing 37 states.
2. 32 co-educational colleges, representing 21 states.
3. 25 women's colleges, representing 19 states.
4. 11 preparatory schools for girls, representing 11 states.
5. 12 normal schools, representing 10 states.
6. 17 high schools in cities with a population over 300,000, representing 12 states.
7. 32 high schools in cities with a population over 100,000 but under 300,000, representing 22 states.

8. 55 high schools in cities with a population over 50,000 but under 100,000, representing 25 states.
9. 47 high schools in cities with a population over 25,000 but under 50,000, representing 30 states.
10. 36 Y.W.C.A.'s, representing 19 states.

The Questionnaire

The following information was called for in the questionnaire:

I. Check the activity carried on for girls and women by your organization. (Herewith followed a long list of activities with space for addition of names of other activities not listed.)

II. If you conduct both intramural and extramural athletics for women, do you have different costumes for each type? Yes, no. (Underline answer).

III. Describe the costumes used by your organization for athletics by filling in following outline. If more than one type of costume is used, describe each one on a separate sheet, adding more sheets as necessary and carefully numbering each sheet under correct headings as listed below. *For each description attach a drawing or catalog cut-out or photograph of the costume.*

A. Costume I.

1. Used for (name activities) .....
2. Used for *extra*mural or *intra*mural alone, or both? (Underline answer.)
3. Attach illustration to this page.
4. Was this costume selected by a man, a woman, a group of men, a group of women, a group of men and women, or the persons who wear them? (Underline answer.)
5. What relation does the person (or persons) who selected this costume have to your organization for which athletics are promoted? .....
6. Description of costume.
   a. Is the costume one piece or two pieces? (Underline answer.) (If one piece, use "b" below for description of whole garment plus "c" (1)-(6)-(7)-(8)-(9)-(10).
   b. Blouse or substitute.
      (1) Type: shirt, middy, jersey, blouse, waist. (Underline answer.)
      (2) Approved material or materials: cotton, wool silk. (Underline answer.)
      (3) Approved color or colors: black, white, light color, dark color. (Underline answer.)
      (4) Price range .....
      (5) Is the use of this garment required or optional? (Underline answer.)
      (6) Sleeves: long, short, none. (Underline answer.)
      (7) Neck line: "V" shape, square, round. (Underline answer.)
      (8) Collar: large, medium, small, none. (Underline answer.)
      (9) Tail of blouse: long, short, teddy finish. (Underline.) Worn in or out of bloomers? (Underline.)
      (10) Fastenings: Where? shoulder, under arm, back, front, none (slip on). (Underline answer.) With what? buttons, hooks, snaps, zipper. (Underline answer.)

c. Bloomers or substitute.

(1) Type: bloomers, knickers, trunks (shorts). (Underline answer.)
(2) Approved material or materials: cotton, wool, silk. (Underline.)
(3) Approved color or colors: black, white, light color, dark color. (Underline answer.)
(4) Price range.
(5) Is the use of this garment required or optional? (Underline answer.)
(6) Knee or leg finish: elastic, knitted band, self band; loose fitting or snug to leg at finish. (Underline answer.)
(7) Leg length: to knee, half way to knee, very short (crotch). (Underline answer).
(8) Waist finish: elastic, self belt or belted. (Underline answer.)
(9) Fastenings: Where? front, 1 side, 2 sides. (Underline answer.) What? buttons, hooks, zipper, snaps. (Underline answer.)

7. Accessories to Costume.

a. Garment worn over blouse.

(1) Type: jersey, tunic or ..... (Underline or fill in.)
(2) Approved material or materials: cotton, wool, silk. (Underline answer.)
(3) Price range .....
(4) Is the use of this garment required or optional? (Underline answer.)
(5) Sleeves: long, short, none. (Underline answer.)
(6) Neck: "V" shape, square, round. (Underline answer.)
(7) Collar: large, medium, small, none. (Underline answer.)
(8) Attach illustration to this page if not included in first illustration.

b. Hose.

(1) Approved material or materials: cotton, wool, silk. (Underline answer.)
(2) Approved color or colors or combinations of colors: black, white, light color, dark color, any color. (Underline.)
(3) Price range .....
(4) Worn (a) to meet bloomers or substitute for bloomers, (b) above knee but not meeting bloomers or substitute, (c) just below knee, (d) three-fourths to knee, (e) ankle socks, (f) none. (Underline answer.)

c. Shoes.

(1) Approved material of uppers: canvas, leather or ..... (Underline answer or fill in.)
(2) Approved material of sole: cork, rubber, composition, leather. (Underline answer.)
(3) Approved color: black, white, brown, white with black trim, white with brown trim or ..... (Underline or fill in.)
(4) Price range .....

(5) Style shoe:
(a) Sandal, oxford, ankle height, above ankle. (Underline answer.)
(b) Heel: 1 inch, ½ inch, thickening of sole to form slight heel (spring heel), none. (Underline answer.)

d. Undergarment.
(1) Type: bathing suit, union suit, ordinary lingerie or ..... (Underline or fill in.)
(2) Material: cotton, wool, silk. (Underline answer.)
(3) Price range .....
(4) Is the use of this garment required or optional? (Underline answer.)

e. Extra over garment for cold weather out of doors.
(1) Type: sweater, sweat shirt, blazer, lumber jacket, sheepskin, or ..... (Underline or fill in answer.)
(2) Unlined or lined in wool, cotton, leather. (Underline.)
(3) Price range .....
(4) Is the use of this garment required or optional? (Underline.)

B. Costume II. (Fill in if a second costume is used—attach more paper as needed. Use same headings as in "A" above for Costume I.

C. Attach to this page drawing or photo of swimming suit you use.

D. Attach to this page drawing or photo of interpretative dancing costume you use.

E. Attach to this page drawing or photo of dancing undergarment you use.

Sports Engaged in by American Girls

A study of the replies to the questionnaire shows that there are nine sports engaged in by large numbers of girls and women. In addition to these nine there are twelve other sports used but no one of these claims a large following. The entire list is given below in the order of popularity of the various sports.

Activity	No. of the 10 groups using it	Per Cent of the 320 organizations using it	Used most by	Per Cent of use by this group	Used least by	Per Cent of use by this group
1. Basketball	All 10	90	Preparatory Schools and High Schools of cities over 300,000	100	Y.W.C.A.'s	69
2. Volleyball	All 10	90	Normal Schools, High Schools of cities over 300,000 and Y.W.C.A.'s	100	Women's Colleges	62
3. Baseball (girls' rules)	All 10	85	High Schools of cities 50,000 or over	100	Y.W.C.A.'s	50
4. Tennis	All 10	79	High Schools of cities over 300,000; Co-educ. Colleges, Women's Colleges, and Preparatory Schools.	100	High Schools of cities 25,000 or over	57
5. Swimming	All 10	65	Women's Colleges	100	High Schools of cities 25,000 or over	38
6. Field Hockey	All 10	46	Women's Colleges	95	Y.W.C.A.'s	25
7. Archery	All 10	45	Women's Colleges	87	High Schools of cities 25,000 or over	14
8. Track and Field	8	46	Women's Colleges	79	Normal Schools	0

9.	Soccer	All 10	44	Normal Schools	67	Y.W.C.A.'s	8
10.	Golf	All 10	22	Preparatory Schools	41	Small Towns	6
11.	Horseshoe Pitching	All 10	18	Universities	34	Y.W.C.A.'s	2
12.	Ring Tennis	All 10	15	Universities	34	High Schools in cities over 50,000 and small towns	4
13.	Bowling	All 10	13	Normal Schools	50	Preparatory Schools	0
14.	Speedball	All 10	13	High Schools of cities of over 300,000	31	Y.W.C.A.'s	2
15.	Fencing	8	9	Universities	23	High Schools in cities of over 50,000	0
16.	League Baseball	All 10	9	Normal Schools	16	High Schools in cities of over 50,000	4
17.	Rifle Marksmanship	4	8	Universities	25	Co-educational Colleges	6
18.	Paddle Tennis	10	8	High Schools of cities of over 50,000	16	Preparatory Schools	0
19.	Quoits	7	6	High Schools of cities of over 300,000	18	Women's Colleges	4
20.	LaCrosse	3	2.6	Women's Colleges	12		
21.	Horseback Riding	3	2	Preparatory Schools	25	Women's Colleges	1

Costumes Used for Athletics and Gymnastics

Costumes Selected by Men or Women?

In practically all cases where the costume is selected by some one person, that person is a woman and usually she is the director of the physical education work for girls. In a few preparatory schools the principal of the school selects the costumes. In only five cases are costumes selected by some one man, four of these cases occurring in high schools in towns of from 50,000 to 100,000 population, the fifth case occurring in a Y. W. C. A., strange as it may seem. This Y. W. C. A. reports that it hopes for a change in this procedure in the near future but, at the present time, the industrial groups of their city select a man coach who selects the costumes for the federated teams. The Y. W. C. A. merely heads up this federation and accepts the costume already selected.

In many organizations, the costume is selected by a group of persons rather than by one person but in all of these cases there is only one group which has its costume selected by a group of persons, all of whom are men. This case occurs in a normal school. Frequently costumes are chosen by a group made up of both men and women. These cases invariably occur in the high schools. Two colleges also report such arrangements, one being a state university and the other a co-educational college.

The greatest number of costumes are selected by a group of women and as a rule these women are the director of physical education for girls and her staff although quite frequently another woman on the costume selection committee is the dean of women or the woman principal of the school.

In a very few cases the girls themselves select the costumes. This occurs in one preparatory school, in three high schools and in two Y. W. C. A.'s. In still more cases the wearers of the costumes merely assist in the selection of their costumes. This occurs in six universities, in seven co-educational colleges, in one women's college, in two preparatory schools, in two normal schools, in fifteen high schools and in seven Y. W. C. A.'s. In one normal school and in one high school the costume is selected by a group of men and the girls.

The three colleges in which men help select the athletic costumes are University of Tennessee, Marysville College, and William and Mary College. The two normal schools in which men help in the selection are Wisconsin State Normal School at La Crosse, and Pennsylvania State Normal School at West Chester. The four high schools in which the costume is selected by a man are Harrisburg, Pennsylvania, and three senior high schools of Gary, Indiana. The organizations in which the girls themselves select their own costumes are the high schools of Utica, New York, Atlantic City, New Jersey, and

Richmond, Indiana, Miss Porter's School for Girls at Farmington, Conn., and the Y. W. C. A.'s of Portland, Oregon, and St. Paul, Minnesota.

The following chart gives the number of organizations for these various groups:

Selected by:	In Colleges	In Prep. Schools	In Norm. Schools	In High Schools	In Y.W.C.A.'s	Total
A man, alone				4	1	5
A woman, alone	46	4	5	42	8	105
A group of men			1			1
A group of women	62	5	3	43	13	126
A group of men and women	3	14		24	9	27
The wearers themselves		1		3	2	6
Women and the wearers	14	2	1	14	7	38
Men and the wearers			1	1		2

The selection is made by such a wide variety of groups that the following list is inserted for the reader's entertainment as much as for his enlightenment.

Costumes Selected by:	No. of Cases
The Director of Physical Education	104
The Director of Physical Education and Physical Education Staff	103
The Director of Physical Education and the College Dean	6
The Director of Physical Education and Executive Committee of the School	4
The Director of Physical Education and a committee of mothers	2
The Director of Physical Education and the Athletic Board	2
The Director of Physical Education, Secretary of School Board and Assistant Supervisor of Physical Education and the Principal	2
The Director of Physical Education, the School Board and the Director of Recreation	1
The Director of Physical Education and the Physical Education students	14
The staff of Physical Education and the Dean	3
The staff of Physical Education and the Principal	2
The staff of Physical Education and the Principal and the Dean	2
The staff of Physical Education, the Principal, the Dean and the students	1
The staff of Physical Education and the Board of Supervisors	3
The staff of Physical Education and Superintendent	2
The Coach and Dean of Women	1
The Coach and the Principal	1
The Board of Supervisors	1
The Dean of Home Economics Department	1
The Dean of the College	1
The Principal of the School	4
The Industrial Secretary of Y. W. C. A.	1

The School Advisors	2
The Y.W.C.A. Secretaries	1
The Athletic Board	1
Someone connected with the schools	1
The students	2
The Advisory Board and Student Council	1
A Special Costume Committee of the School	4
The Athletic Board, Coach and girls	1
The Y. W. C. A. officials and team sponsors	2
The Supervisor of Physical Education and Superintendent of the Organization	1
The Dean of the college and the wife of the President	1

One Piece or Two Piece Costumes

A decided choice is shown in this survey by all varieties of groups for the two piece costume in preference to the one piece costume, as is indicated by the chart below.

	Use 2 piece costume	Use 1 piece costume	Ratio pref. 2 pc. to 1 pc.
Universities	49	3	16 to 1
Co-educational colleges	27	5	5 to 1
Women's Colleges	21	4	5 to 1
Preparatory Schools	10	1	10 to 1
Normal Schools	11	1	11 to 1
High Schools in cities of over 300,000 population	13	4	3 to 1
High Schools in cities of over 100,000 population	28	4	7 to 1
High Schools in cities of over 50,000 population	36	19	2 to 1
High Schools in towns of over 25,000 population	36	11	3 to 1
Y. W. C. A.'s	34	2	17 to 1
Totals	265	54	5 to 1

(Note that the one piece suit finds its greatest following in the high schools of the towns with a population of from fifty to one hundred thousand.)

It appears that the two piece suit is decidedly the more popular of the two types of garments, yet it is interesting to note that many organizations described a two piece costume for this survey but closed their replies with a statement that they were changing to a one piece costume for the coming year. The few who described the new costume for the future described the typical light color cotton suit used by most organizations reporting a one piece garment. This indicates a growing popularity for the one piece suit. In no case was there reported a prospective change from a one piece to a two piece costume.

From unofficial reports and chance conversations with physical directors from many parts of the country held at numerous confer-

ence and committee meetings since these questionnaires were filled out, the writer learns of an apparent tremendous swing that is in progress at this very moment from the two piece woolen suit to the one piece wash garment. Numerous directors have reported directly and indirectly that although they reported on a two piece costume, they have since changed to a one piece wash costume. An article in the October, 1930, issue of the JOURNAL OF HEALTH AND PHYSICAL EDUCATION by Aldrich, entitled "The Evolution of Gymnasium Clothing for Women," states "the most abrupt, rapid and radical change of all time has taken place...during the past year. A new idea, starting like a prairie fire simultaneously in several separate localities, spread in no time at all over the whole country. This idea was colored wash suits for the gym....there is hardly a school, public or private, no matter how remote that has not heard of and is not interested in the new wash suits. The dream of the physical director has come true." These statements cannot help but carry much weight coming directly from a manufacturer of gymnastic costumes who must surely have his finger on the pulse of the public most interested in his wares. And it is interesting that these statements tally so closely with the above mentioned unofficial reports and conversations.

It is true that many of these popular wash suits are two piece suits but three different manufacturers of these garments state that it is the one piece suit that is calling for the largest and most frequent orders at this time.

Apparently this questionnaire was sent out just at the zero hour before a sudden change was to take place. It was sent out almost a year before the above mentioned article was written. It is unfortunate that it was caught just in this unexpected transition time but it does give an accurate picture of the condition existing in 1929-30 and it does show this start of a swing towards the one piece wash suit.

The One-Piece Suit

Type

The one piece garment falls into four distinct types: the romper suit, the romper suit with a very short skirt attached, the jumper suit with a guimpe, and a garment similar to the romper except that it fastens down the front. There is a fourth type, the tunic worn over tights, but since the tights are listed with the tunic for price and must necessarily accompany it, it seems thereby to fall in the two piece class. Yet it is so entirely different from the other two piece garments in style, since it cannot be divided into blouse and bloomers, that it seems not to belong to this class either. Since only two such costumes were reported as requirements it may be sufficient to merely mention them here, state that they appear only in the university group and

cost, the one, $10.00, the other $11.00 for both the tights and tunics. With this recognition of their existence, we will include them in neither the one piece nor two piece costume descriptions. Such treatment is accorded them merely because of the difficulty to class them and the fact that they concern only two out of 320 organizations.

The romper type is found in all groups and claims 88 per cent of all one piece garments; the romper type with the short skirt is found in the college class only, and claims 2 per cent of the one piece garments; the jumper suit with the guimpe is found only in the colleges and high schools and claims 7 per cent of the one piece costumes; the romper type that buttons down the front is found only in the high school class representing 2 per cent of the one piece costumes.

The field belongs quite definitely to the romper type of costume which is usually sleeveless (although short sleeves are reported in one third of the cases) and with a V neck (although 12 per cent of them have a round neck) and usually collarless (although 31 per cent of them do have a small collar). This costume fastens on one shoulder and under one arm. In a few cases it fastens at both shoulders.

Colors and Materials

Eighty per cent of these costumes are of light colors and in all cases but one they are of cotton material. Of the 80 per cent that are of light colors, some are merely designated as light color, others as green, others as blue, and others as white. Of the remaining 20 per cent not listed as light colors, some are dark blue, some are black, some are just "dark" and others are "any color." The one color that is most popular is light green with bright blue following a close second. Green leads in the colleges, but blue leads in the high schools.

The following chart shows the popularity of the various colors:

Light colors —40 % of the one piece costumes.
Light green —19+% of the one piece costumes.
Light blue —17+% of the one piece costumes.
Dark blue — 6+% of the one piece costumes.
Black — 6+% of the one piece costumes.
White — 4+% of the one piece costumes.
Dark colors — 4+% of the one piece costumes.
Any color — 2+% of the one piece costumes.

Length of Bloomers

There are four bloomer lengths used: the length coming all the way down to the knee, the length coming three-fourths of the way to the knee, the length coming only half way down to the knee and the extremely short leg length. The first and third mentioned tie for honors in the groups as a whole and also within the college and high school groups. The very short bloomer is found only in the

high school group and represents only 2 per cent of the whole one piece costume class. The two extremes for length are in the high schools for it is there that the full leg length occurs in greatest numbers and in many of these cases there is a positive requirement that the bloomer must come to the knee and must be worn so. Full leg length bloomer and one-half to knee length each claims 43 per cent of the one piece costumes. The three-fourths to knee length claims 10 per cent and the very short length only 2 per cent.

Hosiery Used with a One Piece Costume

The ankle sock is the most popular and after that comes the full length hose that meets the bloomer. There is little attention shown the stocking that comes above the ankle but below the knee. The order of their popularity is as follows: ankle length used by 62 per cent; full length, by 26 per cent; just below the knee, by 8+ per cent; three-fourths to the knee, by 2+ per cent. The colleges are equally divided on full length and ankle socks with one piece costumes. The high schools use ankle socks in preference to full length hose in ratio of over three to one.

As to color, the white stocking is far in the lead and this is to be expected since the ankle socks lead and they are in almost every case used in the white. Black follows for second place which is not a surprise since full length stockings hold second place and almost invariably the full length stocking required is a black cotton hose. Following is the list of the various colors of hose used in the order of their popularity:

White used by 42 per cent; black by 25 per cent; any light color by 17 per cent; any color, light or dark, by 10 per cent; gray and tan, each 2 per cent.

As to materials of hose, cotton leads by 53 per cent, followed by wool by 26 per cent and the remaining 20 per cent used by organizations permitting any material the wearer desires.

Price Range of One Piece Costumes

The price range is $7.25, with $2.60 representing the average price of these costumes. The highest price paid is $8.00 which is paid by a co-educational college using a jumper suit of serge with a guimpe. The next price is $5.00 paid by a normal school, using a romper suit of Irish poplin, and by one high school using a cotton romper suit. The third highest price is $4.50, paid by a university using a cotton romper suit. The lowest price paid is $0.75, paid by a high school in a town of 25,000 to 50,000 population, using a romper suit which the students or their mothers make from the school pattern. The next lowest price is $0.78 paid by a high school in a town of

50,000 to 100,000 population, using a romper suit made of gingham in light colors. The third lowest price is $1.00 paid by a high school in the same class with the $0.78 suit, using a romper of white cotton material.

The price chart for these costumes is as follows:

Price	Colleges	Normal Schools	High Schools	Y.W.C.A.'s	All Groups as a whole
Highest	$8.00	$5.00	$5.00	$3.00	$8.00
Lowest	2.00	5.00	0.75	2.50	0.75
Average	3.43	5.00	2.27	2.75	2.60

The average is raised by the one piece jumper suits of woolen material.

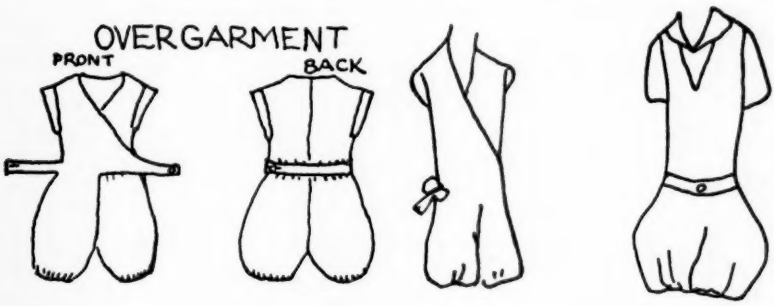
The "Typical" One Piece Costume

The typical costume is a romper style of light green cotton material. It fastens under the arm and on one shoulder and is self belted. It is sleeveless and has a "V" neck. The bloomer comes either half way to the knee or entirely to the knee. It costs around $2.60. The stockings worn with this costume are white cotton ankle socks.

The Most Popular One Piece Costume

Other One Piece Costumes in Use

Three Types of Jumper Suits Used by a Few Organizations



The Blouse of the Two-Piece Suit

Type

The college and normal school girls use a shirt style of blouse in preference to all other types while the high schools and Y.W.C.A.'s prefer the middy type. The preparatory school girls are divided between their choice of shirts and middies. The jersey is used very little, only one ninth as often as the shirt and middy.

Material and Colors

Cotton is used by all groups by an overwhelming majority, the ratio being thirty blouses of cotton to one of wool or wool and cotton combined.

All groups prefer white to all other colors. The report gives 69 per cent for white, 15 per cent for light colors, 7 per cent for black, 8 per cent for dark colors.

Optional or required

The use of the blouse, selected by the person or persons given authority to select it, is compulsory in 86 per cent of the groups and optional in 14 per cent. The high schools of the smaller towns and the Y. W. C. A.'s make up practically all of this 14 per cent.

Sleeves, Collars, Tails and Fastenings

The sleeves are short rather than long. Next to the short sleeved blouse in popularity is the blouse without any sleeves at all. Short sleeves claim 61 per cent of the costumes, no sleeves 22 per cent, and long sleeves 13 per cent. There are very few blouses that are not "V" shaped in the neck. 89 per cent are "V" shaped, 10 per cent are round, and less than 1 per cent are square. As to collars, a small one is used the most frequently. It is used on 46 per cent of the blouses, the medium collar on 28 per cent, no collar at all on 21 per cent, while large collars are used on only 3 per cent of the blouses. The large collar is used in the high schools five times to once in any other class of groups, but even there it is used infrequently.

The tail of the blouse is worn tucked inside of the bloomers in 64 per cent of the cases, and worn on the outside in 35 per cent of the cases. The colleges use the tucked in tail of blouse in six cases to one in which the tail of the blouse is worn outside, although their ratio of shirt and blouse type to middy type runs only 3 to 1. Apparently even middy type is used in many colleges with the tail of the middy worn inside the bloomers. The preparatory schools are equally divided between middies and shirts and, as one would expect, are equally divided as to tails of blouses worn in or outside of bloomers. The normal schools show a ratio of four to one in preference of

shirt type of blouse over the middy type and they too, as one would expect, show the same ratio of blouses with tails worn inside of the bloomers to the number of blouses with tails worn outside of the bloomers. The high schools and Y.W.C.A.'s show a marked preference for the middy type of blouse over any one other type. Yet the number of shirt types of various kinds such as shirts, jerseys, blouses, waists, all grouped into one class, ties with middies in both groups. And this shows up in the tie in these two groups for the "tail in" with "tail out" blouses. 56 per cent of all blouses used have "teddy" finish.

The great majority of the blouses slip on over the head and are without fastenings. Most of those that do have fastenings use buttons in the front of the blouse. There is only one organization that uses a blouse that fastens in the back and that organization is one of our state universities.

Price Range

The price range for blouses is $5.00 with $1.72 representing the mean average price. The lowest price paid is fifty cents, which price is found in one high school in a town of over 300,000 population, in two high schools in towns of 100,000 to 300,000 population, and in one high school in a town of 50,000 to 100,000 population. The next lowest price is seventy-five cents found in one co-educational college and in nine high schools, these nine high schools being scattered among all four types of towns covered in this survey.

The highest price paid for blouses is $5.50 found in a woman's college, although that price is optional with the students. The next highest price is $5.25 found in another woman's college. The third highest price is $4.50 found in a preparatory school.

The average price for all groups is $1.72. The following chart gives the lowest, highest, and mean prices for the various groups.

Group	Lowest Price	Highest Price	Mean Price
Universities	$0.95	$2.50	
Co-educational colleges	.75	3.75	— $1.90
Women's Colleges	1.00	5.50	
Preparatory Schools	1.25	4.50	2.25
Normal Schools	1.00	2.25	1.58
Cities over 300,000	.50	2.75	
Cities over 100,000	.50	3.00	— 1.64
Towns over 50,000	.50	3.50	
Towns over 25,000	.75	4.00	
Y.W.C.A.'s	.95	3.00	1.55
All groups as a whole	.50	5.50	1.72

It is interesting to note that the top notch price asked for blouses mounts as one moves from the larger to the smaller town high

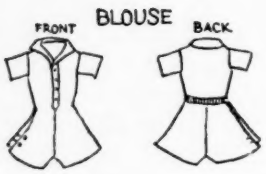
schools. Note that the lowest mean occurs in the Y.W.C.A.'s with the highest in the preparatory schools.

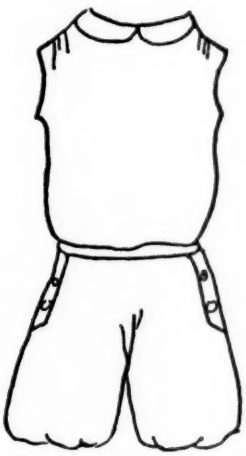
The "Typical" Most Used Blouse

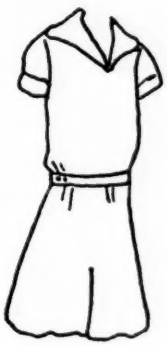
This blouse, like the typical freshman, may be non existent but it can be described as follows: white cotton shirt or middy with short sleeves, a "V" neck, a small collar, and no fastenings. It is slipped on over the head and is worn with the tail inside the bloomers, the tail being long and with the "teddy" finish. It costs $1.72.

The Typical Blouse

Other types used.







Bloomers, Knickers or Trunks

Types

The three types of garment used for the lower part of the costume are bloomers, knickers, and trunks (or shorts). They are used in the following percentage of cases: 53 per cent for bloomers, 31 per cent for knickers, and 14 per cent for trunks.

Bloomers are used to the greatest extent by the high schools, with 65 per cent use, while they are used the least in the normal schools, with 40 per cent use there. Knickers are used to the greatest extent in the normal schools with 60 per cent use followed closely by 51 per cent use in colleges. They are used least in the Y.W.C.A.'s, with only 7 per cent use. Trunks or shorts are used most in the Y.W.C.A.'s, with a 44 per cent use, and are used not at all in normal schools, and only 7 per cent in colleges.

The following chart gives the relative use of each type of garment for each group.

Group	Bloomers	Knickers	Trunks (Shorts)
Colleges	42 %	51 %	7 %
Preparatory School	54 %	27 %	18 %
Normal School	40 %	60 %	0 %
High Schools	65 %	20 %	14+%
Y. W. C. A.'s	47 %	7+%	44+%
All groups as a whole	53 %	31+%	14+%

No group prefers trunks to the other two types but the colleges and normal schools prefer the knickers, while the preparatory schools, high schools, and Y.W.C.A.'s prefer the bloomers.

Materials and Colors

For all groups as a whole the use of cotton for materials of these garments predominates considerably over other materials, with wool used the next most, although it is less than half as popular as cotton. In each separate group, cotton holds first place except in the normal school group. There cotton and wool tie for honors and are the only materials used. A mixture of cotton and wool is used in many organizations although it takes third place in choice in all groups except in the Y.W.C.A.'s where it ranks considerably below cotton but a little above wool, and except in the high schools where it ties with wool for second place.

The following chart shows the preferences for the various materials used.

Groups	Cotton	Wool	Cotton and Wool	Silk	Cotton and Silk
Colleges	43+%	38+%	14+%	1+%	1+%
Prep. Schools	53 %	38 %			7+%
Normal Schools	50 %	50 %			
High Schools	75 %	12 %	12+%		
Y.W.C.A.'s	57 %	20 %	22+%		
All groups as a whole	59 %	25+%	13 %	— 1 %	— 1 %

Notice that cotton is used the most by the high schools and the least by the colleges; wool is used the most by the normal schools and the least by the high schools; cotton and wool is used the most by the Y.W.C.A.'s and not at all by the preparatory schools and normal schools; cotton and silk is used the most by the preparatory schools and silk is used the most by the colleges although its use there is almost negligible.

Seventy per cent of all groups as a whole use black for the color of these garments while 90 per cent of the whole use either black or some other dark color. Of the various groups, the normal schools use black in the highest percentage with 88 per cent, while the preparatory schools use it the least with only 46 per cent. The colleges, high schools, and Y.W.C.A.'s use black in 71 per cent, 73 per cent, and 51 per cent of their cases respectively. Dark colors other than black are used the most in the preparatory schools with 38 per cent use. The Y.W.C.A.'s follow closely on their track with 37 per cent use. Colleges have a 19 per cent representation for dark colors and high schools 15 per cent while the normal schools do not use dark colors other than black.

White or light colors are used very little, only in 9 per cent of the organizations. The percentage of their use by the various groups is as follows: colleges, 7 per cent; Y.W.C.A.'s, 10 per cent; normal schools, 11 per cent; high schools, 12 per cent; preparatory schools, 15 per cent.

Required or Optional Use of Garment Selected

Eighty-nine per cent of all groups require the use of the particular type of garment selected. The colleges and high schools, with very few exceptions, make the use of the approved garment required. The Y.W.C.A.'s require the use of the specified garment only in seventy-three per cent of their organizations. The percentages for

requirement are as follows: for high schools, 95 per cent; for preparatory schools, 92 per cent; for normal schools, 90 per cent, and for Y.W.C.A.'s 73 per cent.

Description

Since the bloomer and knicker types are so predominately popular, the knee finish is of course found to be elastic in the great majority of cases, 80 per cent to be exact. The leg finish of the loose fitting style is reported in only 5 per cent of all the groups.

As to length of garment there is little difference between the various groups. On the whole they show a slight preference between the length that comes half way to the knee although the knee length itself is almost as popular. There are only a very few groups using garments that are between these two in length. The same number of groups use a very short garment, one that is shorter than half way to knee length. The following chart shows the preferences of the various groups.

Groups	Knee Length	¾ Length	½ to Knee	Crotch Length
Colleges	50 %		49+%	
Preparatory Schools	46 %		46+%	7+%
Normal Schools	50 %		50 %	
High Schools	48+%	1+%	49 %	1+%
Y.W.C.A.'s	28+%	3+%	67+%	
All Groups as a Whole	46 %	1+%	51 %	1+%

Bloomers and knickers are most frequently self belted although garments with separate belts are quite popular. In fact the extra belt garment holds first place in the high schools and Y.W.C.A.'s. The colleges and preparatory schools show a preference for self belts and the normal schools are equally divided in their choice between the two types of waist finish. Only seven per cent of the groups use elastic for the waist finish of the bloomers, knickers, or trunks, forty-two per cent use belts, and fifty per cent use self belts. The use of elastic at the waist is divided among all groups, being used most by preparatory schools and least by colleges.

These garments almost invariably fasten on the side and usually on only one side rather than on both sides. One preparatory school, one Y.W.C.A., and three high schools use a garment with a front fastening but all others use the side fastening with seventy-six per cent use of one side only. The fastenings themselves are usually buttons. This is true in eighty-four per cent of the groups with the zipper fastening ranking second (although far removed second) with

only eight per cent of use, hooks third with four per cent use, and snaps used least with a two per cent usage. The zipper fastening is used only in the high schools and Y.W.C.A.'s with the exception of one college, but at that it is decidedly in the minority as are hooks and snaps.

Price Range

The price range on bloomers, knickers, or trunks is $10.35, the lowest price paid being sixty-five cents and the highest price paid being $11.00 The average price paid however is $2.49. The lowest price of sixty-five cents is used by a high school in a town of population between 25,000 and 50,000. The next lowest price is sixty-seven cents, used in a high school in a city of over 300,000 population. The third lowest price is seventy-five cents used in a high school in a town of population between 50,000 and 100,000 and by a preparatory school. A price of eighty-five cents is used by a Y.W.C.A. while a price of ninety-five cents is used by two universities and two Y.W.C.A.'s.

The highest price of $11.00 is used by a university. The next highest price of $10.00 is used by a Y.W.C.A. An $8.00 price is used by a women's college; $7.00 by a Y.W.C.A., and $6.00 by a Y.W.C.A. and by a women's college.

The price chart follows:

Group	Lowest Price Reported	Highest Price Reported	Average Price
Universities	$ .95	$11.00	—$2.78
Co-educational colleges	1.50	5.50	
Women's colleges	1.75	5.50	
Preparatory schools	.75	5.50	2.84
Normal schools	1.50	4.00	2.51
High schools			2.13
Cities over 300,000	.67	4.50	
Towns over 100,000	1.00	5.00	
Towns over 50,000	.75	5.50	
Towns over 25,000	.65	5.50	
Y.W.C.A.'s	.85	10.00	2.56
All Groups as a Whole	.65	11.00	2.49

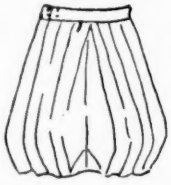
The "Typical" Garment

The typical garment is the circular bloomer made of black cotton material. It has elastic for knee finish and comes half way to the knee. It is finished with a self belt at the waist and fastens with buttons on one side. It costs $2.49.

Garments used by most organizations

Circular Bloomers

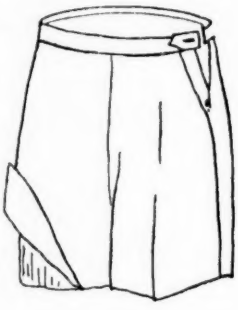
Knickers



Plaited Bloomers

Garments used by a limited number of organizations

Trunks



Overblouse Accessory to Costume

Only one fifth of the organizations as a whole have a requirement of an overblouse as a part of the costume. But taking each group by itself we find that 33+ per cent of the colleges and women's schools have such a requirement as do 45 per cent of the preparatory schools. But only 11+ per cent of the Y.W.C.A.'s and 9+ per cent of the high schools have such a requirement.

Of the groups using such a garment the preference is decidedly for the jersey by 83 per cent of these organizations; then follows the tunic used by 12+ per cent, and the sleeveless jacket used by 4+ per cent.

Most frequently these over garments are of wool though cotton is used considerably. They are sleeveless oftener than they are long sleeved. In rare cases they have short sleeves. The neck is occasionally round and it is almost always collarless.

The price range for these garments is $4.50, the highest price being $5.00 and the lowest $0.50. The average price paid is $2.08.

This highest price of $5.00 is paid by only one school, a high school in a town of 50,000 to 100,000 population. The lowest price is $0.50 used by a college. The lowest average is paid by the high schools as a whole and the highest by the preparatory schools. The price chart follows.

Price	Colleges	Prep. Schools	Normal Schools	High Schools	Y.W.C.A.'s	Whole Group
Highest	$3.50	$3.50	$2.75	$5.00	$3.00	$5.00
Lowest	.50	2.00	.75	.75	2.00	.50
Average	2.15	2.62	1.80	1.65	2.16	2.08

Types of overblouse in use

Undergarments

Type

There is practically no requirement as to undergarments that shall be worn with gymnastic and athletic costumes. The usual rule is that the wearer uses her regular lingerie. In most groups there is practically no special garment required. In 4 per cent of the colleges and in less than 1 per cent of the high schools there is a requirement of a bathing suit type of garment and in 11+ per cent of the colleges and 6 per cent of the high schools and 8+ per cent of the normal schools there is a requirement of a special union suit. In still fewer cases the costume is worn without an under-garment at all. The following chart shows this tendency.

Requirement	All groups as a whole	Colleges	Prep. schools	Normal schools	High schools	Y.W.C.A.'s
Regular lingerie	81+%	74+%	100 %	91+%	84+%	76+%
Special union suit	8+%	11+%	0 %	8+%	6+%	0 %
Regular lingerie or special union suit	3+%	4 %	0 %	0 %	.9+%	14+%
Special bathing suit type	2+%	4 %	0 %	0 %	.9+%	9+%
Regular lingerie or no garment at all	2+%	1+%			2+%	
Brassiere only	1+%				2+%	
No garment at all	.4+%				.9 %	
Regular lingerie or special bathing suit type	.5+%	1+%				
Anything one wishes to wear	.4+%	1+%				

Materials

When there is a special undergarment required the material required is cotton in almost all cases.

Price Range

The price range is $3.25 with $1.37 representing the average price paid. The highest price used by the few organizations that do have a special undergarment requirement is $3.75 used by one co-educational college. The next highest price is $3.00 named by one Y.W.C.A. The lowest price is $0.50 used by two high schools in towns of population between 50,000 and 100,000 and by one high school in a town of 25,000 to 50,000. The next lowest price is $0.75 and it is found in one university, in one high school of a city of over 50,000 population, and in one high school of a town over 25,000 population.

The highest average is found in the Y.W.C.A.'s and the lowest in the high schools. The women's colleges and preparatory schools and high schools of cities over 100,000 population report no requirement for a special undergarment. The price chart for the garments that are used is as follows:

Price	Colleges	Prep. Schools	Normal Schools	High Schools	Y.W.C.A.'s	Whole Group
Highest	$3.75	.....	$1.75	$2.50	$3.00	$3.75
Lowest	.75	.....	1.75	.50	1.00	.50
Average	1.46	.....	1.75	.94	2.00	1.37

Overgarment for Out-of-Doors

The most popular garment used as a requirement for out-of-door use is the sweatshirt, required by 39 per cent of the organizations replying to the question. The optional use of any garment follows as a close second in popularity, with the sweater taking third place, and a fourth place is listed, but scarcely used, by the blazer. This last type of garment is required only in the preparatory school group and is as popular there as is the sweatshirt, although neither enjoy much popularity since the decided record in their case goes to the optional use of any garment.

First place for the high schools, normal schools, and preparatory schools goes to optional garment, but first place for colleges and Y.W.C.A.'s goes to the sweatshirt. The sweater does not rank first in any group, yet it is more popular in the high schools than is the sweatshirt.

The highest percentage use of sweatshirts as a requirement goes to the Y.W.C.A.'s, followed by the colleges and the lowest percentage use goes to the preparatory schools. The sweater is required most in the high schools, and not at all in the preparatory schools, normal schools, and Y.W.C.A.'s. The greatest option of use of any garment occurs in the normal school, the least in the Y.W.C.A.'s.

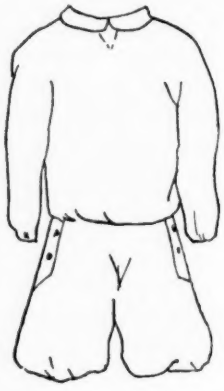
The price range of these garments we find to be $14.25 with $2.59 representing the average price paid. It is the sweater that raises the average so materially. The sweatshirts themselves vary in price from $0.75 to $2.00. The following chart includes both sweaters and sweatshirts and the very few blazers that were reported and one expensive leather jacket in the preparatory school group.

Price	Colleges	Prep. Schools	Normal Schools	High Schools	Y.W.C.A.'s	Whole Group
Highest	$5.00	$15.00	$3.00	$15.00	$1.50	$15.00
Lowest	.85	1.50	1.00	.75	1.00	.75
Average	1.92	7.25	2.00	2.72	1.41	2.59

The chart showing comparative use of sweaters, sweatshirts, blazers, and leather jackets in organizations that have such a requirement for out-of-door activities, follows:

Price	Colleges	Prep. Schools	Normal Schools	High Schools	Y.W.C.A.'s	Whole Group
Sweatshirt	34 %	14+%	20 %	24+%	85+%	39+%
Sweater	15+%			33+%		22 %
Blazer		14 %				0.6+%
Leather Jacket	1+%					0.6+%
Choice of above	29+%	71+%	80 %	41+%	14+%	37+%

The "typical" sweatshirt most in use



Hosiery Worn with Gymnastic and Athletic Costumes

Materials

Cotton is the usual requirement in material for stockings, it being used more frequently than even an optional use of any materials. Silk is never a requirement in any group, although it is no doubt used considerably in the 16+% of all groups that permit the use of any kind of hosiery. The greatest freedom in this way is permitted in the Y.W.C.A.'s and preparatory schools, the least freedom in the high schools. The greatest requirement of cotton hose is found in the high schools, followed by the normal schools; the least requirement in the Y.W.C.A.'s and preparatory schools. In all groups there are from 7 per cent to 10 per cent of the organizations using wool.

This chart shows the rating of the various groups in regard to materials used for hosiery.

Groups	Cotton	Wool	Silk	Optional
Colleges	70 %	8+%		20+%
Prep. Schools	69 %	7+%		23 %
Normal Schools	72 %	9+%		18+%
High Schools	77+%	10+%		10+%
Y.W.C.A.'s	62+%	10 %		27+%
All groups as a whole	73 %	9+%		16+%

Colors

Colleges, preparatory schools, and normal schools permit an optional use of materials for hose much more frequently than they permit an optional use of colors. From a study of the two charts on material and colors it is apparent that many organizations dictate the color that must be used, but permit the wearer to choose the material. On the other hand, the high schools permit a greater freedom in selection of color than in the selection of material. This greater freedom is not marked, however, since there is only a 10 per cent freedom in choice of materials and a 12 per cent freedom in choice of colors. First place in all groups is for black hosiery and it is almost twice as frequent as is the requirement for the color ranking second place, namely, white. In colleges the black requirement is more than twice as frequent as is the white requirement; in normal schools it is almost three times as frequent; in high schools and Y.W.C.A.'s not quite twice as frequent; and in preparatory schools the requirement for black ties with the requirement for white.

The greatest requirement for the use of black hose occurs in the normal schools, the least in the preparatory schools; the greatest requirement for use of white hose occurs in the preparatory schools, the least in the colleges. The greatest freedom in choice of colors is permitted in the Y.W.C.A.'s, the least freedom in the high schools and colleges.

Many organizations do not name black or white for their requirement but merely state that the hose must be of a light color, as occurs in 8+ per cent of all groups; or must be of a dark color, as occurs in 5+ per cent of all groups. The most frequent use of light colors as a requirement occurs in the preparatory schools, which also rank highest in the requirement for white. The least use of light colors as a requirement occurs in the Y.W.C.A.'s. The greatest use of dark colors as a requirement falls in the Y.W.C.A. class, next in the high schools, then colleges, and occurs not at all in the preparatory and normal schools.

Following is a chart showing the rating by groups for requirements as to color of hose.

Groups	Black	White	Light Color	Dark Color	Any Color
Colleges	53+%	22+%	6+%	4+%	12+%
Prep. Schools	33+%	33+%	16+%		16+%
Normal Schools	72+%	27+%			
High Schools	42+%	29+%	10+%	5+%	12+%
Y.W.C.A.'s	42+%	23+%	3+%	7+%	23+%
All groups as a whole	47+%	26+%	8+%	5+%	12+%

Hose Lengths

In no detail of the athletic and gymnastic costume except in the color of shoes is there such wide variation as occurs in regard to the length of hose required. In most details of this survey the groups as a whole show a leading tendency and almost invariably each group within itself conforms to that tendency. But in this detail, taking all groups as a whole the tendency is towards the use of ankle socks, this requirement being quite well in the lead over the second highest requirement, that of full length stockings. Yet within the various groups the requirement for ankle socks does not lead in any but two cases, the Y.W.C.A.'s and high schools, although there the lead is so great that it gives ankle socks first rating on the whole. In the colleges, preparatory schools, and normal schools, first place is given to the full length stockings that meet the bloomers, with ankle socks taking second place. In colleges there is little difference however between the two in percentage of requirements. As to ankle socks the highest percentage of requirement falls in the Y.W.C.A.'s but it

Types of hose lengths required	All groups as a whole	Colleges	Prep. School	Normal School	High Schools	Y.W.C.A.'s
Ankle socks	42+%	30 %	16+%	27+%	53+%	54+%
Full length to meet costume	28+%	37 %	41+%	63+%	22+%	12+%
Just below knee	11+%	13 %	16+%		8+%	19+%
Optional for lengths below knee	6+%	5 %	16+%		8+%	6+%
Either full length or ankle	4+%	7 %		9+%	3+%	3+%
Either full length or just below knee	2+%	1 %	8+%		1+%	3+%
Three-quarters length to knee	2+%	3 %			1+%	
Any length	1+%	2 %			0.8+%	
Above knee but not meeting costume	0.7+%	1 %			0.8+%	
Either full length or just above knee.	0.3+%	1 %				

almost ties with the high schools. The lowest per cent of requirement occurs in the preparatory schools. As to full length hosiery meeting the bloomers, the highest percentage of requirement occurs in the normal schools, the lowest in the Y.W.C.A.'s.

Third place goes to the requirement of stockings that come to just below the knee. It does not occur frequently, however, in any group nor in all groups as a whole, clearing in the last case only 11+ per cent requirement. This type of hosiery requirement occurs most frequently in the Y.W.C.A.'s in 19+ per cent cases; next in the preparatory schools in 16+ per cent cases. It occurs in no cases in the normal schools and in only 8+ per cent of the cases in high schools.

The great variations permitted and required are shown in the accompanying chart and the types are listed in the order of their frequency with all groups as a whole. Notice that the greatest range of variation, 10, occurs in the college group and the least range, 3, in the normal school group.

Price Range

The price range for hose is $2.40, with 56c representing the average price paid.

The highest price paid for hose by any organization is $2.50. This is found in a high school of a town with population between 50,000 and 100,000. The next highest price is $2.00 found in one coeducational college, one preparatory school, and one high school in a town of population between 100,000 and 300,000. The lowest price is 10c used by a women's college, a Y.W.C.A., and a high school in a town of population between 25,000 and 50,000. The next lowest price falls between 10c and 19c and five organizations fall in this grouping: one women's college and one high school of each of the population groupings of this survey. Fifty-two organizations use hose priced between 20c and 29c and organizations in every group are represented by these fifty-two. The price chart follows:

Price	Colleges	Prep. Schools	Normal Schools	High Schools	Y.W.C.A.'s	Whole Group
Highest	$2.00	$2.00	$1.00	$2.50	$1.25	$2.50
Lowest	.10	.20	.25	.10	.10	.10
Average	.58	.82	.60	.50	.61	.56

Note that the high schools hold the lowest average and the preparatory schools the highest average.

Shoes

Uppers

Canvas is almost the universal requirement for uppers of shoes. The colleges and normal school groups are practically the only groups using any other material. They do have a ten and nine per cent requirement for leather but their canvas requirement is 83 per cent and 80 per cent with a 6 per cent and 9 per cent requirement in either canvas or leather. The groups show the following requirements:

Groups	Canvas	Leather	Choice—Canvas or Leather	Any Material
Colleges	83 %	10 %	6 %	
Prep. Schools	84+%		15+%	
Normal Schools	80+%	9+%	9+%	
High Schools	97+%	0.7+%	1+%	0.7+%
Y.W.C.A.'s	90+%		6+%	3+%
All groups as a whole	90+%	4+%	4+%	0.6+%

Soles

The rubber soled shoe is by far the most popular for use with gymnastic and athletic costumes. Composition soles lag far behind in second place with cork ranking third and leather almost negligible.

The group requiring rubber in the highest percent is the high school, with the preparatory schools having the least requirement in rubber, although it is however their highest requirement. The greatest option occurs in the preparatory schools with the least in the high schools. Cork and leather are used only in the colleges and there in a very small per cent of the organizations.

The high percentage of option permitted is rather surprising. The chart may be of interest.

Groups	Rubber	Optional	Composition	Cork	Leather
Colleges	70+%	18 %	7+%	2+%	0.9+%
Prep. Schools	61+%	23+%	15+%		
Normal Schools	63+%	18+%	18+%		
High Schools	84+%	11+%	4+%		
Y.W.C.A.'s	77+%	15+%	7+%		
All groups as a whole	77+%	14+%	5+%	1+%	0.3+%

Colors

The variation in colors of shoes is even greater than that in the lengths of hose. The range of variety in the colleges and high schools is the greatest with ten each and the least in the normal schools with only three. There is no variation, however, as to first choice. All

groups show a marked preference for white shoes. No color or combination of colors runs a close second to all white. It holds the field with a wide margin. Second place goes to all black with a combination of black and white following for a very close third place. The second choice of black does not hold true for all groups, however. The preparatory schools do not use an all black shoe at all. Their second choice goes to a combination of white and black with the third choice going to a combination of white and brown. The Y.W.C.A.'s also depart from the standard set by all groups as a whole when it comes to second and third choices. Their second and third places tie, going to a choice between white and black and all white or a choice between all white or all black.

The all white shoe has its greatest popularity in the preparatory schools and its least popularity in the colleges, although ranking first in both groups. The all black shoe has its greatest popularity in the normal schools, its least popularity in the preparatory schools. The combination white and black shoe is most popular in the preparatory schools and least popular in the normal schools. The combination of white and brown is used only in the preparatory schools and in a very limited number of high schools. The gray shoes are found only in the colleges and there in a very limited number; the all brown only in the high schools and in small numbers.

The following chart is an interesting study.

Colors	All groups as a whole	Colleges	Prep. Schools	Normal Schools	High Schools	Y.W. C. A.'s
All white	49+%	36+%	60 %	54+%	54+%	43 %
All black	12+%	16+%		27+%	12+%	3+%
Combination of white and black	11+%	15+%	20 %		9+%	9+%
Choice of white or white & black	9+%	8+%	10 %	18+%	8+%	18+%
Choice of all white or all black	7+%	11+%			3+%	18+%
Choice between all white or white & black or white & brown	4+%	4+%			6+%	
Any color or combination of colors	2+%	3+%			2+%	3+%
White and brown	0.7+%		10 %		0.8+%	
All gray	0.7+%	2+%				
Choice of white or gray	0.7+%	1+%			0.8+%	
White & brown	0.7+%		10 %		0.8+%	
All brown	0.3+%				3+%	
All crimson	0.3+%			0.8 %		

Style of Shoes

So prevalent is the use of the shoe of ankle height that it leads in all groups by a very large margin. The questionnaire called for answers on four types but from the drawings and illustrations sent in with replies it was quite apparent that there was confusion in the minds of many as to the difference between a shoe of ankle height and a shoe of above ankle height. Practically all who claimed the use of a shoe above ankle height, if they sent in an illustration at all, sent one of ankle height. As a result, after much deliberation, it was decided to combine these two types into one class and call them all "ankle height." At least the replies were clear that the shoes indicated are higher than an oxford.

All groups agree on first choice for ankle height and all except the Y.W.C.A.'s agree on the oxford for second place.

The Y.W.C.A.'s permit the use of any type as its second choice. The highest percentage of use of the ankle shoe occurs in the high schools, the lowest percentage in the Y.W.C.A.'s. The greatest percentage of use of the oxford occurs in the Y.W.C.A.'s with the lowest percentage in the high schools. Also the greatest option of choice we find in the Y.W.C.A.'s with the least in the high schools.

The following chart indicates the relative popularity of the three types and optional choice.

Groups	Ankle Ht.	Oxfords	Sandals	Optional
Colleges	66+%	17+%	0.8+%	15+%
Prep. Schools	60 %	30 %		10 %
Normal Schools	80 %	20 %		
High Schools	82 %	9+%		7+%
Y.W.C.A.'s	53+%	21+%		25+%
All groups as a whole	72+%	14+%	0.6+%	12+%

Heels of Shoes

The spring heel is preferred by all groups to any other type of heel for athletic and gymnastic costumes, it being used over twice as frequently as its nearest rival, the shoe with no heel at all. The greatest requirement for spring heel occurs in the normal schools. The least occurs in the preparatory school group. The greatest requirement of no heel occurs in the Y.W.C.A.'s, the least in the normal schools. The greatest requirement of a half inch heel occurs in the preparatory schools, the least in the normal schools, although the half inch heel is used very little in any group.

The greatest leeway in choice of heels is permitted in the Y.W.C.A.'s and the least in the colleges. Following is the chart concerning heels as used by the various groups.

Groups	Spring Heel	No Heel	½-in. Heel	Optional
Colleges	57+%	28+%	8+%	6+%
Prep. Schools	40 %	30 %	20 %	10 %
Normal Schools	63+%	26+%		9+%
High Schools	62+%	29+%	1+%	7+%
Y.W.C.A.'s	44+%	37+%	3+%	14+%
All groups as a whole	59+%	27+%	4+%	7+%

The Price Range of Shoes

The price range on shoes is $7.00 with $2.10 representing the average price paid. The highest price paid is $7.50 used by one university. The next highest price is $6.50 used by one high school in a town of population between 50,000 and 100,000. The third highest price is $5.00 used by two universities, one co-educational college, one woman's college and one preparatory school. The lowest price paid is 50c, by one co-educational college, one high school in a town of 50,000 to 100,000 population, and one high school in a town of 25,000 to 50,000 population. The next lowest price is 65c, by two normal schools and two high schools in towns of population between 50,000 and 100,000. Twenty-two other organizations pay under $1.00 for their shoes. The women's colleges have $1.00 for their lowest price, being the only group without some organization falling under the $1.00 price.

Note in the following chart that the Y.W.C.A.'s show the lowest average and the preparatory schools the highest.

Price	Colleges	Prep. Schools	Normal Schools	High Schools	Y.W. C.A.'s	Whole Group
Highest	$7.50	$5.00	$3.25	$6.50	$4.00	$7.50
Lowest	.50	.90	.60	.50	.75	.50
Average	1.93	2.38	1.80	1.66	1.49	2.10

The "Typical" Shoe

The "typical" shoe is the white canvas shoe of ankle height with rubber soles and spring heel, costing on the average $2.10.

The Special Costume Used for Extramural Activities

The organizations engaging in extramural (inter-school or intercollegiate) sports are in a decided minority but of those organizations, only 24 per cent use a special costume for such activities.

While the words "trunks," "shorts," "zips," were most conspicuous by their almost complete absence in the description of the costumes used by the three hundred and twenty (320) groups for intramural activities, they jump into decided prominence in the descriptions of costumes used by those organizations that do have special garments for their extramural work. Why this should be true can only be left to conjecture since the questionnaire failed to ask why a special costume of this sort is used in extramural work in preference to the regulation costume used by all other members of these organizations.

In practically every case the "other" costume used is quite in keeping with the sort of costumes used by the great majority of all groups but as soon as an organization steps into the public lime light with an extramural program it seems to feel that its special costume (in case it has one) must keep pace with a publicity policy. In almost all cases these costumes (especially the basketball costumes) are decidedly mannish, most of them even using "trunks," "shorts," or "zips," which garments are quite similar to boys' basketball trunks. One high school even furnishes long sweat pants as well as sweatshirts for its team. Many of these costumes are furnished by the school boards or athletic associations for the "varsity" teams. One high school has a special costume for its "first string" team, apparently a gorgeous affair of red satin trunks and white silk blouse and still another special costume for its "second string" team, a costume not so gorgeous but still resplendent with red wool trunks and red wool jersey. Both of these groups of costumes are furnished by the school board. For the school girls of common clay at this same school there is the requirement of black cotton trunks, white cotton middy, and the middy has long sleeves "which may be rolled when the girls are indoors."

Not all organizations sponsoring extramural programs use special costumes apart from those used for intramurals. In a few cases those that do not have a special "varsity" costume do, however, use for their regular intramural program the type of costume usually used for "varsity" work, but, on the other hand, in the most cases, those that do not have a special "varsity" costume for extramural activities are content to use the usual type of intramural costume for both forms of activities.

One school uses the same style of costume for both but differentiates by using the school colors in the "varsity" garment. This happens to be a garment of white blouse with dark knicker-bloomers. Another school differentiates between the intramurals and extramurals in costumes by using a silk poplin tunic in the school colors over the one piece costume used for intramurals. A college uses the same style for both, a jumper suit with blouse guimpe but requires

the "varsity" suit to be made of garnet colored French serge while the regular costume is of black serge.

A few of these schools have special costumes for various sports. Practically all of this group have special basketball suits. A few have a tennis costume requirement of sleeveless tennis dress. One or two have a special hockey tunic outfit for their hockey teams.

Of the organizations using special extramural costumes, fifty-six per cent use trunks, shorts, or zips for this costume while twenty-eight per cent use bloomers and sixteen per cent use knicker-bloomers. Almost invariably these garments are of wool or flannel and in colors rather than in black. Some of them have strips of contrasting colors for a side trim and belt trim.

To go with these trunks, bloomers and knickers, sixty-two per cent of these organizations use jersies, thirty-three per cent use waist blouses and four per cent use middies. The jersies are of wool and are usually sleeveless with V neck and no collar—the slip-on variety. They are used in all sorts of gay colors. Only twice is white reported. Frequently they have arm and neck bands of contrasting colors and naturally these colors are those used in the trunks.

Woolen ankle socks are the rule for these costumes; sometimes white but usually with a band of color to match the costume. Two organizations report the use of hosiery that comes to just below the knee and one reports the use of opera length wool hose to match the color of the jersey with all white ankle socks used in addition. All others report for ankle socks.

The price of these costumes runs from $3.50 to $8.00 with $6.04 representing the average cost.

The typical extramural garment in cases where a special costume is used is illustrated below. Please note, however, that these costumes are used by no more than four per cent of the whole group involved in this survey; therefore, they do not in any way represent popular opinion.

The Dancing Costume

Interpretative Dancing

Dancing costumes fall into three distinct types, the costume for natural dancing, the rhythms costume and the practice costume. The first costume is made of all sorts of materials, but A. B. C. silk, silk jersey, and crepe de chine bid for the great majority. There seems to be no one style in greatest popularity. The five most used styles are as follows:

Rhythms

The "rhythms costume"—reported by a few high schools and colleges—is made of silk or chambray or gingham. The only two illustrations sent are of the same style. They merely show a variation in belts which makes the two costumes look somewhat different at a casual glance.

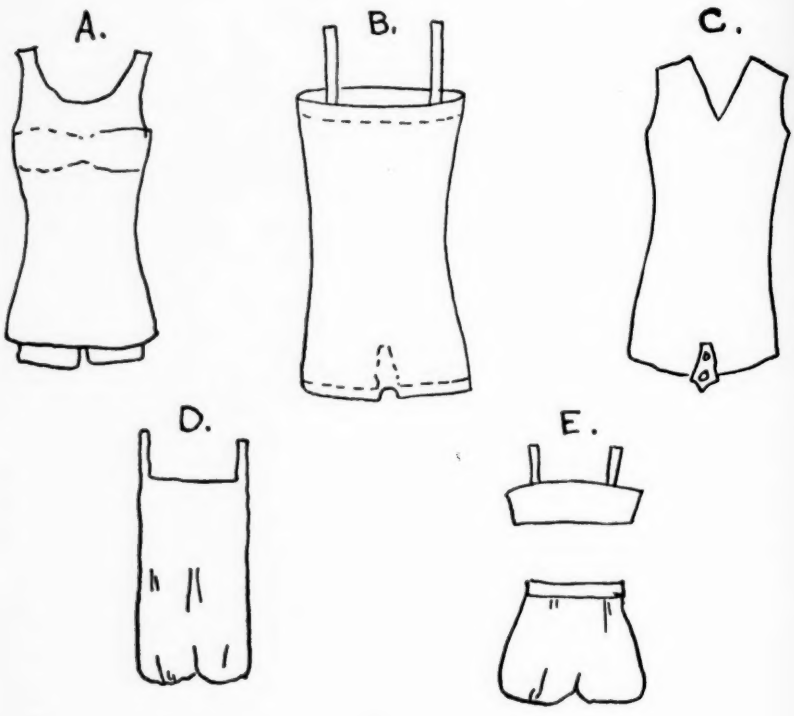
RHYTHM COSTUME

Practice Work

The practice costume is of romper style and is invariably reported as made of gay colored ginghams or of plain wash materials with gay colored trimmings.

Undergarments

Undergarments for dancing fall into five groups with A and B of the following illustrations leading in popularity. A, B, and C garments are of knitted jersey material similar to cotton bathing suits and are dyed in colors to match or contrast with the over-garment. D and E are of silk or imitation silk.



Footwear

Many organizations require the use of bare foot sandals while many do bare foot work. Only one school reports the requirement of ballet slippers. Stockings with dancing costumes apparently do not exist except in the case of one school which reports "no stockings worn except for public performances."

The Swimming Suit

The most used swimming suit is the gray cotton one piece suit with the short skirt, round neck and high armholes. However the skirtless suit is used by many organizations. A very few schools use colors other than gray. In a few cases of "varsity" swimming, woolen suits are required. One organization submits this report which is entirely different from any other received: "Required for racing—a black silk suit with skirt, and a purple wool suit worn over the silk one before and after each race; for diving events a woolen suit, and for use between events a white sweatshirt."

A few groups report that life savers use white caps and all others must use colored caps.

Miscellaneous

Two schools require their students to have berets to use for out-of-door work and one school board supplies woolen caps with center tassels in the school colors for the extramural hockey team.

A number of schools stress the requirement that the stockings must meet the bloomers; the pupils are not to roll the stockings down away from the bloomers or pull the bloomers away from the stocking top. In regard to use of dresses for certain sports there appear such regulations as the following: "there shall not be hiatus between the top of stockings and the lower part of the underwear"; "the underwear must be such that when the person is active there shall not be an exposure of the bare leg between the top of the stocking and the underwear."

One school states that the lower edge of the trunks must come to within five inches of the center of the patella. One college announces that the skirt of the hockey tunic must measure four inches from the ground from a kneeling position.

Such announcements carry the writer back in memory to her own college days and the opening of important local matches in field hockey. She recalls how she and her team mates were lined up before the coach with her inevitable yard stick and woe to the player who was caught with a skirt that measured either more or less than six inches from the ground! Then there was a rule that the ball could not be caught in the skirt and now we talk of tunics measured by the number of inches from a kneeling position! Surely it is better so.

Some schools require the purchase of two blouses and still others require three. The stocking requirement runs from one to four pairs of the regulation hose. Perhaps the most interesting single requirement is the following:

Required Gymnastic Uniform

1 navy worsted V neck sleeveless jersey	$2.50
1 navy wool serge bloomers, Wheeler pattern	3.00
2 white broadcloth combination shirts, elastic sport belting, roll collars, long sleeves, each $4.50	9.00
1 pair high white sneakers, "Keds"	2.25
4 pairs black cotton ribbed "gym" stockings, each 50c	2.00
1 navy imported French beret tam	1.00
	$19.75

Conclusion

A study of price ranges reveals the fact that the high schools are the most economical buyers. For every article listed their average falls under the average listed for all groups as a whole, except in the case of the overgarment for outdoor use. In that instance the high schools and the preparatory schools both show an average above the whole average and therefore can be blamed for keeping

that total average as high as it is. The burden of this guilt must fall on the preparatory school, however. Both groups might well consider the use of the economical sweatshirt in preference to the more costly sweater and thereby make a saving in the high school girl's expenses.

The high school is the only group falling below the general average in its average cost of the one piece suit, the bloomer, the undergarment, and the hose. It is in this group that we find the greatest use of the economical wash suit. All other groups if interested in economy for their pupils should take notice of this fact. The normal school, followed by the college, is the party guilty of keeping up the average cost of the one piece suit.

The colleges run above the general average on every item except on the outdoor overgarment and shoes. But they are in no instance far above. Their greatest deviation is in the matter of one piece suits. Many rather expensive serge suits occur in this group and so keep up their average.

The preparatory schools run above average in the cost of every article, although their greatest deviation comes in the outdoor overgarment. A few leather jackets, blazers, and sweaters raised their average materially in this respect.

The normal schools run above average on their average cost of four articles and under average on four articles, their greatest deviation falling in the case of a few serge one piece suits, raising their average on that garment.

The Y.W.C.A.'s show averages on five articles above the general average and on three articles below the general average. In all cases they are very near the general average, however. Of the four groups within the high school group itself the lowest averages usually fall in the cities of the largest population and conversely the highest high school prices are paid by the high schools of the towns of least population.

Following is a composite chart of averages given on all price range charts of this survey. The prices starred represent the average falling below the general average of the whole group.

Average price for	One piece suit	Blouse	Bloomers	Overblouse	Undergarment	Overgarment for outdoors	Hose	Shoes
Colleges	$3.43	$1.90	$2.78	$2.15	$1.46	*$1.92	$.58	*$1.93
Preparatory schools		2.25	2.84	2.62		7.25	.82	2.38
Normal schools	5.00	*1.58	2.51	1.80	1.75	*2.00	.60	*1.80
High schools	*2.27	*1.64	*2.13	*1.65	* .94	2.72	*.50	*1.66
Y.W.C.A.'s	2.75	*1.55	2.56	2.16	2.00	*1.41	.61	*1.49
All as a whole	2.60	1.72	2.49	2.08	1.37	2.59	.56	2.10

Before purchasing gymnastic and athletic garments a study of the minimum prices paid for the various articles by various groups might be of as much value as is a study of averages in helping you to arrive at a decision for your organization. For that reason the following composite chart of least prices is offered. (The prices starred are the least of the least prices.)

Least price paid for	One piece suit	Blouse	Bloomers	Overblouse	Under-garment	Overgar-ment for outdoors	Hose	Shoes
Colleges	$2.00	$ .95	$ .95	*$ .50	$ .75	$ .85	$.20	*$.50
Preparatory schools		1.25	.75	2.00		1.50	.20	.90
Normal schools	5.00	1.00	1.50	.75	1.75	1.00	.25	.60
High schools	* .75	* .50	* .65	.75	* .50	* .75	*.10	*.50
Y.W.C.A.'s	2.50	.95	.85	2.00	1.00	1.00	.10	.75
All as a whole	.75	.50	.65	.50	.50	.75	.10	.50

From this survey it appears that the girls who dress mannishly or conspicuously or expensively are in the decided minority. Those who dress mannishly or conspicuously are almost invariably involved in a program of interschool or intercollegiate athletics, in which case there seems to exist (whether necessary or not) the idea that the costume should attract attention. In one or two instances one is left wondering what really is in the minds of the girls and their sponsors. What to them is the important thing—the costume or the activity?

On the other hand it is a pleasure to note that the average American girl dresses modestly yet with seemingly sufficient freedom for full active participation in sports. She also dresses conservatively, both as to style and price.

One of the most interesting features of this entire survey is the evidence that there is no such thing as one set of typical gymnastic, athletic, or dancing costumes for the college girl, another set for the preparatory school or normal school girl, another set for the high school girl, and another set for the Y.W.C.A. girl. The great numbers of variations found in all details are scattered throughout all types of groups. There are no peculiarities of costume belonging exclusively to any one type. All variations usually exist in all types and the mythical "typical" article is common to all types of groups.

An Anthropometric Method for Arriving at the Optimal Proportions of the Body in Any Adult Individual

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THE fascinating problem of what the ideal form of the human figure should be is one which has held the interest of mankind from the very beginnings of civilization. Chroniclers of the history of artistic anthropometry adduce evidence to show that the rules or "canons" of proportion used by the ancient Greek sculptors were originally derived from standards devised by the Egyptians, the earliest of which appeared about 3000 B. C.

However, it has been only within comparatively recent years that the subject of bodily proportions has been approached from the standpoint of the anthropologist rather than the artist, with the object of determining the relationship between body form and function rather than the manner in which the human figure may be portrayed most esthetically in design.

In 1870 the Belgian statistician and Astronomer Royal, Adolphe Jacques Quetelet, presented his classic work, "Anthropométrie ou mesure des différentes facultés de l'homme," in which he recorded the typical dimensions of many parts of the body (in Belgians) of both sexes at yearly stages of growth from birth to the adult. Since the time of Quetelet's valuable observations—in which it was shown that differences in the principal external physical characteristics could be definitely accounted for by objective measurement—extensive work by numerous investigators has resulted in the amassment of a staggering amount of data on average measurements of the body, much of which, unfortunately, appears to be of no practical applicability. For while some few studies comprise the major length, diameter, and circumference measurements, most are limited to the two outstanding measures of stature and weight, and *all* present merely the *average* characteristics or tendencies of a given *populace* rather than the *ideal or optimal* characteristics prescriptible for a given *individual.*

The fallaciousness of the so-called "standards" of height and weight as criteria of physical fitness has now become so generally recognized that we shall here limit reference to those tables to a summary statement of cogent reasons for considering them to be of no value in specific cases:—prescribing weight on the basis of height,

alone, omits the imperative consideration of skeletal *thickness;* weight, in itself, even though it be the exact amount prescribed "for height," furnishes no assurance of its symmetrical *distribution* over the bony framework, and fails to indicate whether it is the concomitant of a thin frame excessively flesh-covered, or a thick frame insufficiently flesh-covered; the *average* aspect of physical development (which the height-weight tables represent) has yet to be proved to be the *ideal.*

DESIGNED in view of the shortcomings of many of the "simple, easy-to-apply" (but, *undependable*) rules now in use, the chief purpose of the present paper is to introduce a comprehensive method of anatomic evaluation which prescribes the ideal or optimal proportions of all parts of the body in respect to individual peculiarity of skeletal conformation, and to formulate that method in terms of objective measurements so as to facilitate the obtainment of definite, reliable, and uniform conclusions among all users of the method.

Before proceeding with the details of our subject, it might be well to propound or define *what* condition or status is "normal"—or rather, *"optimal,"* most desirable. Whatever basis or criterion is employed for this purpose should recognize the tendency of the individual to *vary* from the *average* type or status, and should, accordingly, provide for such variation in all cases where the individual presents no ascertainable physiologic inadequacy.

The status of the body form or structure most indicative of and conducive to healthful function is here construed as that in which *symmetry of proportion* exists in all its constituent parts. By "symmetry" we understand the most favorable *proportion* of fleshy development to skeletal development, and the most favorable *distribution* of that fleshy development to the various parts of the figure.

By "optimal" we understand the ultimate status or condition in which all functions of the body proceed in complete harmony and efficiency in accompaniment to health and bodily vigor, inclusive of a zone approximate thereto, in which the observed structural and functional relationships, while not the precise degree prescribed, depart therefrom to an extent not in excess of that determined as admitting of the highest degree of physical efficiency. In other words, the *theoretical* "optimal" is a goal of perfection, in its finer aspects, unattainable; the *practical* "optimal" is a status bordering thereon, but recognizing the infinitude of minor departures and variabilities to which each member of the human species is subject—a goal potentially attainable by any individual presenting no major structural disability or incurable organic disorder.

We shall not here enter into an involved discussion of the underlying geometric principles which obtain co-existent in the human

figure and operate according to immutable law in any augmentation or diminution of the body or its component members in length, breadth, or thickness. Suffice it to mention that the linear, areal, and volumetric properties of the body may be likened to those of a cylinder, the length of which is represented by the stature and the horizontal cross-sectional area of which is represented by the square of the unit taken to denote the general thickness of the skeleton. Through this comparison it is apparent that body weight (volume) should vary as the denoted thickness of the skeleton, squared, multiplied by the stature. Thuswise, variation in volume or weight of the body is accounted for as due not only to variation in its length (stature), but also to variation in the girth or cross-sectional area of its bony framework and the superlying musculation which should vary in correspondence therewith.

These fundamental geometric relationships are herein incorporated in the rules and ratios to follow, and insure that all prescribed measures are mutually consistent.

ALTHOUGH a survey of pertinent literature justifies us in believing that the principle, hereinafter presented, of arriving at the implied general thickness of an individual's bony framework and of prescribing all the girth and diameter measures of the body on the basis of that bony thickness, is original, the recognition that each individual should be proportioned throughout in accordance with the characteristics of his own constitution can be traced back at least to the time of Leonardo da Vinci. Remarking on that universal genius, in regards to his views on the proportions of the body, the Italian painter, Guiseppe Bossi (1777-1815), says, "He thought but little of any general measure of the species; and that the true proportion admitted by him, and acknowledged to be of difficult investigation, is solely the proportion of an individual in regard to himself, which, according to true imitation, should be different in all the individuals of a species, as is the case in nature. Thus, says he, 'all the parts of any animal should correspond with the whole; that which is short and thick, should have every member short and thick; that which is long and thin, every member long and thin; and that which is between the two, members of a proportionate size.' From this and other precepts it follows, that, when he speaks of proportion, he is to be understood as referring to the harmony of the parts of an individual, and not to the general rule of imitation in reference to dimensions." Leonardo's judgment on the question of bodily proportions is the premise upon which the present method has been formulated.

A principle herewith of importance is, that the body dimensions prescribed by the present method are based on size-relationships typically prevalent between *structurally (or better, kinesiologically)*

associated parts of the body. That is, in the derivation of the various ratios herein adopted as criteria of optimal size-relationship (proportion), measurements of thickness were related to such other measurements of thickness as were co-existent and co-regulated by presumably the *same* physiologic growth-factor. Such relationships serve to unify and justify large girth dimensions in a person having a thick-set frame and small girth dimensions in a person having a slender frame, irrespective of whether the thick-set person is short in stature or the slender person tall in stature. Also, when ratios derived from the relationship in size of *functionally associated* parts of the body are used as criteria of proportion, a much smaller number of observations (because of the comparative uniformity of the ratios derived therefrom) will suffice for the deducing of reliable conclusions than is the case when similar correlations are attempted between characteristics such as stature (length), and weight (volume), which are *not* directly associated. This statement is not made in defense of our own comparatively limited data, but simply as an important, readily-verifiable truth.

THE basic information preliminary to the present study consists of the measurements of 52 adult male subjects and 20 adult female subjects, the large majority of whom presented excellent proportion and condition in *two or more of the anthropometric characteristics related,* and all of whom presented a general status of physique ranging by visual adjudgment from good to excellent. It might at this point be opportune to mention the extreme improbability of any one individual presenting optimal proportions in *all* parts of the body, regardless of what method is used as a criterion.

The optimal physical status prescribed by the present method concomitates optimal size-relationship between each and all of the component bodily parts. The precise value of each ratio determined as optimum was, in the respective contributing series of individual ratios, *the mean or representative value which remained after such individual values as were deemed unduly aberrant were excluded.* In interpreting what was an "unduly" aberrant value—one whose inclusion would influence contrarily the clearly-defined tendency of the central values—the author's judgment entered the otherwise impersonal accounting. However, this unavoidable discrimination was applied in substantial degree only in reference to certain outstandingly apparent discrepancies in the size of fleshy parts, as in the case of comparative under-development of one part due to athletic specialization on other parts, or disproportionate enlargement of a part due to localized adipose accumulation.

To define summarily the status of physique we shortly propose to reconcile with the anatomic potentiality of every individual: the optimally-proportioned man or woman as interpreted and prescribed

by the rules here presented is a *composite of optimally-proportioned parts;* the "optimal" proportion being the *typical size-relationship between any two parts as expressed by a ratio;* this typical ratio in turn being the *mean of a series of individual ratios derived from physically select subjects,* and expressing in the parts compared the *size-relationship characteristic of individuals symmetrically developed and formed in those parts.*

TABLE 1, "Ratios of Physical Proportion," presents the series of percentile relationships determined for various associated parts of the body. The outcome of these initial relationships is incorporated in Tables 2 and 4, the meaning of which will be explained in due order. In Table 1, the status of ratio, "Primary" or "Secondary," signifies respectively, *1)* the ratios derived from a comparison of those parts most directly size-related, and *2)* the ratios following as an arithmetic consequence of the relationships expressed by the primary ratios. For example, if in the male the optimal girth of hips is found to be 4.260 times the ankle girth, and the knee girth .3934 times the girth of hips, the knee girth is as a consequence established as 1.676 times the ankle girth. By this procedure—first establishing the ratios occurring between parts of the body most uniformly size-related in different subjects, then confirming those ratios by reciprocal comparisons [of other (secondary) size-relationships with those *implied* (made consequential) by the primary ratios]—the optimal ratios of size-relationship existent between, and assignable to, any and all parts of the body were ultimately established.

In the tabulation of basic data, the respective subjects are grouped according to sex and listed (i.e., assigned numbers) in those groups according to weight. In arriving at the optimal ratio for each of the measurements related, the ratios were identified by the respective *number* assigned to each subject and tabulated in order of *magnitude.* Convincing evidence, from an anatomic standpoint, of the validity of the principle of basing a standard of physical proportions on *ratios* rather than on absolute *dimensions,* appears in the tabulations of individual ratios for various measurements—*all of which show an utter lack of correspondence between the size (weight) of the subject and the magnitude of the ratio.* Which, conversely, means that these ratios obtain equally in persons of *all* sizes.

It is understood, of course, that these ratios are not presented as final, incontrovertible values. But an examination of Table 1 will disclose that in a comparison of the respective minimum and maximum (individual extreme) ratios, a majority show close conformity. This conformity is especially significant in view of the limited number of subjects comprised, and of the fact that these subjects, though limited in number, varied enormously in respective size and proportion. The latter fact may be ascribed to the athletic character of the

TABLE I

RATIOS OF PHYSICAL PROPORTION

Derived from the correlation of 52 sets of measurements of male subjects and 20 sets of measurements of female subjects.

Dimensions related	Sex	Number of individual ratios		Status of ratio: Primary (1) Secondary (2)	Ratio presented			Ratio adopted as optimum or ideal
		recorded	utilized		minimum	mean	maximum	
Girth of Hips / Ankle girth	M	51	41	1	4.062	4.260	4.447	4.260
	F	20	18	1	4.267	4.537	4.921	4.537
Knee girth / Girth of Hips	M	52	44	1	.3835	.3934	.4053	.3934
	F	20	17	1	.3562	.3738	.3856	.3737
Knee girth / Ankle girth	M	51	45	2	1.589		1.762	1.676
	F	20	16	2	1.610		1.806	1.695
Thigh girth / Girth of Hips	M	52	30	1	.5809	.5961	.6172	.5960
	F	20	8	1	.5775	.5877	.6047	.5874
Thigh girth / Ankle girth	M	51	32	2	2.425		2.763	2.539
	F	20	13	2	2.546		2.935	2.665
Bi-trochanteric diameter / Girth of Hips	M	32	27	1	.3298	.3443	.3539	.3444
	F	12	10	1	.3232	.3331	.3444	.3331
Bi-trochanteric diameter / Ankle girth	M	32	19	2	1.415		1.580	1.467
	F	12	12	2	1.397		1.712	1.511
Calf girth / Thigh girth	M	52	38	1	.6448	.6664	.6989	.6667
	F	20	14	1	.5856	.6179	.6579	.6181
Calf girth / Ankle girth	M	51	22	2	1.646		1.779	1.693
	F	20	13	2	1.579		1.712	1.647
Waist girth / Ankle girth	M	51	49	1	3.194	3.522	3.883	3.522
	F	20	20	1	2.849	3.175	3.579	3.176
Waist girth / Girth of Hips	M	52	35	2	.8021		.8564	.8268
	F	20	20	2	.6539		.7532	.7000
Bi-iliac diameter / Waist girth	M	31	31	1	.3558	.3602	.3947	.3600
	F	12	12	1	.3660	.4212	.4514	.4213
Bi-iliac diameter / Ankle girth	M	31	31	2	1.128		1.362	1.268
	F	12	10	2	1.244		1.452	1.341
Chest Girth / Girth of Hips	M	52	52	1	1.008	1.101	1.223	1.102
	F	20	18	2	.8533		.9606	.8960
Chest Girth / Waist Girth	M	52	40	2	1.275		1.400	1.333
	F	20	19	1	1.218	1.280	1.349	1.280
Chest girth / Ankle girth	M	51	46	2	4.337		5.180	4.695
	F	20	20	2	3.663		4.605	4.065
Neck girth / Chest girth	M	52	52	1	.3358	.3839	.4262	.3839
	F	20	18	1	.3686	.3805	.3908	.3806
Girth of flexed upper arm / Chest girth	M	52	33	1	.3476	.3583	.3741	.3580
	F	20	16	1	.3238	.3346	.3750	.3356
Girth of Forearm / Girth of flexed upper arm	M	52	47	1	.7968	.8358	.8845	.8358
	F	20	20	1	.7792	.8562	.9369	.8562
Forearm girth / Wrist girth	M	52	14	2	1.706		1.833	1.745
	F	20	16	2	1.496		1.644	1.578
Wrist girth / Ankle girth	M	51	50	1	.7432	.8050	.8571	.8050
	F	20	20	1	.6977	.7403	.7871	.7403
Bi-deltoid diameter / Chest girth plus girths of both flexed upper arms	M	49	48	1	.2597	.2731	.2886	.2731
	F	12	12	1	.2816	.2921	.3080	.2925
Bi-deltoid diameter minus bi-acromial diameter / Girth of flexed upper arm	M	31	31	1	.1710	.2217	.2710	.2217
	F	12	9	1	.1658	.2166	.3134	.2170
Both chest diameters / Chest girth	M	32	31	1	.4628	.4896	.5129	.4896
	F	12	11	1	.5164	.5405	.5751	.5400
Transverse Chest diameter / Bi-deltoid diameter	M	32	32	1	.5899	.6181	.6634	.6174
	F	12	12	1	.6136	.6605	.7032	.6606
Antero-posterior Chest diameter / Chest girth minus Transverse Chest diameter	M	32	31	2	.2403		.3235	.2818
	F	12	11	2	.3077		.3606	.3206

subjects, a number of whom presented most unusual development and size-relationship in certain parts of the body as a result of the anatomic disproportion induced by competitive sport or gymnastic specialty. In consequence, there is little reason to fear that these anthropometric ratios would vary to an appreciably greater degree if drawn from the population at large. Therefore, we present these ratios, incorporated in summary formulae, in full confidence and belief that they are applicable to all adult persons; (though probably limited to the white race). (As a practical reference, we may add that the present-described method of anthropometric evaluation (for the adult) has been in use for over two years, as a *routine* measure, in the medical practice of Dr. E. Kost Shelton, Santa Barbara, specialist in disorders of the endocrine system, and has proved itself entirely adequate.)

Now, prior to a description of the method of converting certain specified (actual) skeletal dimensions to a common basis, and subsequently of using that basis for the prescription of symmetrically-proportionate (optimal) dimensions in all parts of the figure, it is essential that a number of physiologic relationships presupposed by that method be stated. There being few of these relationships susceptible to absolute proof, at least at the present time, the assumptions here expressed must serve, by reason of the (demonstrable) extent to which they reconcile observed differences in form, to account for workings of growth otherwise uncorrelated. These hypothetical relationships are:

1. That the growth in *thickness* or diameter of the long bones (the chief constituents of stature) is stimulated by a different growth-impulse than is the growth of those bones in *length,* but that it proceeds in ratio (under optimum conditions, direct ratio) to the growth in length and thickness of the short and flat bones and the irregular-shaped bones (those which contribute to, or determine, the breadth and fore-and-aft depth of the skeleton: the clavicles, the scapulae, the ribs, and the bones of the pelvis). (Which accounts for the possibility of a person of relatively short stature having a skeleton in which the bones of the limbs are thick, and in which the thorax, shoulders, and pelvis are broad and deep, antero-posteriorly; and a person of relatively tall stature, just the reverse: a skeleton thin, narrow and shallow.)
2. That when the metabolic processes are normally active, and for a given sex and anatomical (not necessarily chronological) age, the muscular or fleshy tissues tend to attain a bulk (girth of thickness) in direct ratio to the general thickness of the bones of the skeleton; but, that they develop, as does the thickness of the bones, in response to a different influence than that which determines the length of the long bones or the stature. That is, as an anatomic rule, the thicker and heavier the bones, the larger and more prominent the bony processes; the larger the processes, the thicker the tendons attaching to them; and the thicker the tendons, the bulkier the muscular development (and its correlatives, connective tissue, and normally-present fat-covering).
3. That parts of the body which are associated in muscular action tend to

assume a characteristic relationship in size (girth), and that this relationship, as typified in subjects who by proper exercise have attained reasonably complete muscular development of the parts considered, may by means of proportion (size-relationship) ratios be propounded as "optimal" or "ideal." (Thus, when the upper portion of the figure is uniformly exercised, the neck, arm and waist girths tend to assume a certain relation in size to the chest girths; and, under the same influence of muscular activity, the lower extremities in girth of thigh and calf tend to take on a size in definite relation to the girth of hips.)

(This conclusion is in accord with that of Dr. Raymond Franzen, who, in his excellent monograph concerning children, "Physical Measures of Growth and Nutrition," p. 37, states, "We have assurance, then, that being large muscled is a feature of the organism and not a set of unrelated qualities in different portions of the body.")

4. That, in a rule incorporating the foregoing postulations, the optimal dimensions of horizontal girth and diameter (fleshy and skeletal) in any person may be determined and prescribed in respect to a modulus, compounded from observed dimensions, which expresses the general thickness of skeleton of that person. (The body weight—a concomitant measure, and only of secondary importance—can be prescribed in accordance with the prescribed girth measures and the observed measure in stature.)

SINCE in the foregoing text we have repeatedly stated, or referred to, the fundamental principle obtaining in the method of anthropometric evaluation here introduced—the principle of determining, and prescribing, all measures of girth and diameter, both of the skeleton and of the fleshy parts, on the basis of a unit or modulus representing the general thickness of the bones—it now only remains to explain how that unit of bony thickness is to be arrived at, and which skeletal measurements are to be used as contributing indicators of the bony thickness presented in various regions of the figure.

We should at the outset emphasize that the applicability of the present method to persons of even widely disproportionate bodily conformation is facilitated to an enormous degree by the aforementioned principle of compounding a *modulus* or unit of size from a *number* of observed skeletal dimensions, *each* of which expresses the structural magnitude of a *particular region* of the skeleton. This principle was adopted only after it was apparent that no one measure of skeletal thickness could be assumed, in application to *any* individual, as an index of skeletal thickness in all parts of the frame. In this connection it was reasoned that if a method proposed to accommodate the structural peculiarities of all persons could not be applied satisfactorily to those presenting *extreme unusualness* of conformation, it could not be accepted as basically sound, or therefore correctly applicable even to persons of *ordinary* build. The general applicability of the method here presented in comprehensive form, and the increasing inapplicability of that method in particular cases when fewer and fewer separate measures of skeletal thickness are incorporated therein, compels us to believe that the number of measures

(6) of the thickness of the bony framework herein adopted is the minimum compatible with the derivation, in all instances, of a true index of skeletal thickness.

We have not as yet been enabled to extend the scope of this method (in reference to the prediction of *optimal* proportions) to persons of pre-adult bodily conformation; but, from a formulation of the same method in pertinence to the *average* proportions of the body at all ages (as deduced from available anthropometric statistics), it appears certain that the fundamental principles of size-relationship here applied to the adult age apply also to the developmental ages antecedent thereto.

Thus, to recapitulate: the derivation of representative proportion-ratios from the measurements of the subjects comprising the present study, and the accounting for—by reciprocal application of those ratios—of individual differences in size-relationship as expressed in the measurements of those respective subjects, indicates plainly that no *single* measure of skeletal breadth or thickness can be assumed in the individual as an index of *general thickness* of bony framework. But, it likewise indicates that when *six* measures, representing the degree of skeletal thickness in *various parts* of the figure, are incorporated or converted into a single size-unit, that *unit* may dependably be adopted as a basis from which to determine and prescribe *all* the girth and diameter measures of the body and (with the measure of stature) the weight concomitant thereto.

It must be added, however, that the present method applies with close agreement more consistently among male subjects than among female subjects. This is an inevitable consequence of any rule proposed to reconcile in the individual the natural muscular development with the thickness of the underlying bony framework. For, in the female sex generally, the thickness of the layer of subcutaneous fat in relation to the thickness of musculation varies to a greater extent than in the male. This peculiarity has been ascribed to a fundamental difference in the sexes—in man, the muscular (katabolic) system predominating; in woman, the nutritive (anabolic) system. But, whatever the cause of this difference, the fact remains that woman presents less uniformly-proportioned fleshy development in relation to skeletal development than man; and, until the time arrives when such difference can be interpreted in terms of nutritional balance, we can only determine and prescribe the optimal proportions of the body in woman on the basis of the proportions actually shown in the measurements of different individuals of that sex—individuals *unselected* as to the proportion presented between subcutaneous fat-padding and muscular development.

THE measurements adopted in the present study as criteria of the thickness of the skeleton are: breadth of shoulders (bi-acromial diameter), breadth of pelvis (bi-iliac diameter), breadth of

hips (bi-trochanteric diameter), girth of wrist (average of right and left), girth of knee (average of right and left), girth of ankle (average of right and left). A description of the manner of taking these measurements, and the comparative value or adequacy of each as an index of the general thickness of the skeleton, will be given later. We may now discuss each adopted skeletal measurement as to its capacity for representing the anatomic structure in its respective region, and to its stability in the presence of changes in size in the adjacent fleshy parts of the body. We shall also state our reasons for excluding other skeletal measures.

The bi-acromial diameter is a measurement inter-related with the transverse diameter of the chest, and therefore, indirectly, with the girth of the chest. As has been pointed out by other investigators, the bi-acromial diameter is not a stable dimension, being subject to alteration as the carriage of the shoulders is altered. We also have evidence that it is subject to considerable augmentation from the influence of gymnastic exercises which bring into vigorous action the muscles and joints of the neighboring regions. Notwithstanding these criticisms, the bi-acromial diameter may, as an index of thoracic development, be accepted as more dependable than either the transverse diameter or the antero-posterior diameter of the chest. Its subjection to postural changes of the shoulders may to an extent be obviated by observing the posture of the subject at the moment of measuring, and making sure that the carriage of the shoulders is as natural and uniform as the subject can assume. The bi-acromial diameter has the advantage of presenting definite bony points, which are palpable in practically every case, even when the subject is exceedingly corpulent. For this reason it is particularly useful in cases where the subject presents such excessive adiposity that other skeletal measurements are obscured.

We have not included the transverse and the antero-posterior diameters of the chest as criteria of skeletal thickness, chiefly for the reason that the adequacy of the six measurements adopted is not enhanced by the added use of these chest measurements. Additional reasons for their exclusion are, that they are not analogous to other skeletal measurements, in the respect that they are unstable because of the natural mobility of the chest walls. The antero-posterior diameter is not particularly rejectable for this reason; but the transverse diameter is impossible to take as a bi-costal measure, as if the overlying soft tissues are compressed sufficiently for this purpose the probability is that the ribs also will be constricted to a greater or lesser extent. Hence, by the transverse diameter of the chest, as prescribed in our tabulation, is meant the *maximum* diameter of the chest between the axillæ. Another objection to the so-called transverse chest diameter is that it is markedly altered by the carriage of the shoulders—to a far greater extent than is the bi-acromial diameter.

Evidence in our data points to the chest *girth* as being one of the most important of body measures. Its size in relation to the whole figure, and its well-defined size-relationship to the smaller girth measures of adjoining parts, indicate that (when not invalidated by adiposeness) it is a better criterion of general physical development than is either of the chest diameters. Therefore, it is indicated that the adequacy of the chest diameters as skeletal criteria should be judged by the extent to which either is an index of chest girth, and in this capacity they are found highly variable. A person may have either a small or a large measure in antero-posterior chest diameter for a given measure in the over-all fore-and-aft depth of the chest (i.e., from the front of the breast to the back of the scapula), and yet have properly proportioned musculature in the chest region and no postural defects of the shoulders or scapulæ. Again, a person may have an antero-posteriorly "deep" chest (universally regarded as a sign of exceptional lung-power and capacity to resist pulmonary diseases) by reason of having kyphosis (hump-back) accompanied or unaccompanied by pigeon-breast. Consequently, the much-stressed diagnostic significance of chest depth may be stated only with provisions; another example being that though tubercular persons, as a class, have a lesser depth of chest than is average, a similar shallowness of chest, in the individual, is not invariably a sign of the presence of tuberculosis or even of a predisposition to it.

Regarding the bi-iliac (or bi-cristal) diameter of the pelvis, no condition of variableness, such as obtains in the bi-acromial diameter or in the chest diameters, is encountered. The very structure of the consolidated hip bones assures that any measurement pertaining to them is practically a fixed quantity. About the only objections that can be offered against the measurement of bi-iliac diameter are that, in subjects with pronounced obesity, it is impossible to take with accuracy, and that, like all other measurements of bony thickness, it is in itself insufficient as an index of skeletal development in all parts of the figure. In thin or muscular subjects, the consistent uniformity and precision with which the measurement of bi-iliac diameter can be secured establishes this measurement as one of the most useful indicators of the thickness of the skeleton.

The bi-trochanteric diameter is an important measure, since it is influential in determining the muscular girth measures of the hips and thighs. Although not such a fixed dimension as the bi-iliac diameter, the bony breadth of hips is subject to very slight variation. In taking the bi-trochanteric diameter, the subject should be directed to stand with feet together and pointing straight to the front, so that no inconsistency in this measurement in different subjects be occasioned by posture. In encountering the various forms of obesity, it may happen that in one subject the iliac crests are palpable, but that the bi-trochanteric diameter is thickly fat-padded; while in an-

other subject the reverse is the case, the greater trochanters being sufficiently near the surface to measure satisfactorily, while the bi-iliac measurement is completely obscured. For these reasons, and notwithstanding their close anatomic relationship, we have found it advisable to include both the bi-iliac diameter and the bi-trochanteric diameter as criteria of skeletal thickness.

Apparently, the measurements of wrist girth, knee girth, and ankle girth are regarded by anthropometrists as inadequate indices of the thickness of skeletal development, since in rules heretofore designed to express that development only the skeletal *diameters* are employed. Presumably, these girth measures of the extremities are considered inadmissable criteria of bone-size for the reason that they encompass soft tissues also. In regards to this probable interpretation we can only present our own observations, which are: that the girth measurements here specified, if anything, are *better* criteria than the skeletal diameters. Unless the wrists, knees, and ankles are unduly fat-covered, the fact that girth measurements of those parts includes soft tissues as well as bones in no apparent way impairs the value of those measurements as indicators of the actual thickness of the long bones. For, the major portion of the soft tissues included is a correlative of bone development; that is, tendons and ligaments. Therefore, measurements of fleshy girth prescribed on the basis of these joint girths can be accepted as being in true, even though not direct, relation to the thickness of the bones. Even when the joint girth dimensions are appreciably fat-covered, they are invalidated no more, if as much, than are the skeletal diameters of the trunk under like circumstances. The question has been raised as to whether or not the transverse *diameters* of the joints would constitute better criteria than the girths of those parts.

We have, at the present time, no means of answering this question. The diameter measures should prove more accurate than girth measures in the presence of marked adiposity of the limbs; but, in persons of ordinary muscularity, it is doubtful if any advantage would come from the substitution of diameters for girths, since with the use of diameters the probability of error in measurement would be increased approximately three times unless the unit of measure adopted was a correspondingly smaller one. To summarize this discussion of skeletal girth measurements: in reference to the subjects comprising the present study, it has been found that the bony measurements of wrist girth, knee girth and ankle girth are *each* indispensable as a corroborative criterion of the general thickness of the skeleton, and as a criterion of fleshy development in regions *most closely size-related to that respective bony measurement.*

In consequence, these bony girth measurements are each essential, as a contributing index, in the determining of the *modulus* of skeletal

thickness from which is determined and prescribed the fleshy girth measurements of *all* parts of the body.

It is now opportune to describe how the modulus of skeletal thickness is arrived at from the use, in combination, of the six skeletal measurements adopted.

THE all-important modulus of skeletal thickness is obtained by *first converting each of the six (observed) skeletal dimensions to an amount of value to correspond (in typical proportion) with a chosen one of those dimensions, then adopting as the modulus the mean value of the resultant six values.* As to which one of the six skeletal dimensions is chosen, to which to convert the remaining five skeletal dimensions, it is immaterial. We have herein chosen the ankle girth for this unifying capacity, simply because in the early stages of evolving the present method it was the sole measurement adopted as an indicator of skeletal thickness, and for that reason the size-unit to which we have become accustomed. The modulus obtained from the actual dimension in ankle girth, in conjunction with the corresponding values in ankle girth derived (by proportion-ratios) from each of the remaining five skeletal dimensions, we call, for want of a better term, the "corrected ankle girth."

That is, the "corrected ankle girth" is the mean or representative value of six measures of skeletal thickness, one measure of which (the ankle girth) is that *actually* obtaining or observed, while the five other measures are the values in ankle girth *implied* by the respective measures observed in bi-acromial diameter, bi-iliac diameter, bi-trochanteric diameter, wrist girth, and knee girth. To illustrate: if the typical (optimal) size-relationship between the bi-acromial diameter and the ankle girth, in the adult male, is adopted as 1.83:1.00 (the ankle girth is always taken as 1.00, since it is the size-unit) and if the observed bi-acromial measure is 18.3 inches, the implied measure in ankle girth to correspond therewith is 10 inches; and so on for the conversion of all other skeletal measures to the ankle girth measure.

In deriving the mean value of the six measures in ankle girth, we have found that, to guard against the undue modifying influence of disproportionately large or small individual measures, it is advisable to use a "weighted" average. That is, instead of obtaining an average in the usual manner—by adding the six values and dividing by six—the six values presented are first arranged from lowest to highest; secondly, multiplied respectively by 1, 2, 3, 3, 2, 1; thirdly, added; and finally, divided by 12 (the sum of the "weights"). The advantage of this procedure over a plain arithmetic averaging is to prevent possible unduly aberrant values from exerting a contrariwise influence on the median values, and thereby conduce to the

obtainment of a better index of the *general* thickness of the frame as expressed by the resultant value of "corrected ankle girth."

Incorporating the optimal values presented in Table 1, "Ratios of Physical Proportion," the following ratios express the optimal magnitude of each of the remaining skeletal measurements when the girth of ankle is taken as 1.000. By converse procedure the "corrected ankle girth" is obtained by dividing each observed skeletal dimension by the respective ratio hereunder given and deriving the mean of the six resultant values by the "weighted average" method just described.

TABLE 2

OPTIMAL RELATIONSHIP IN SIZE OF MEASUREMENTS OF SKELETAL THICKNESS

Male		*Female*
1.828	Breadth of Shoulders (bi-acromial)	1.691
1.268	Breadth of Pelvis (bi-iliac)	1.341
1.467	Breadth of Hips (bi-trochanteric)	1.511
.8050	Girth of Wrist	.7403
1.676	Girth of Knee	1.695
1.000	Girth of Ankle	1.000

The latter procedure, for all sizes of "corrected ankle girth" ordinarily encountered, is facilitated by Tables 3a and 3b, for male and female subjects respectively, from which may be read directly the ankle girth measure to correspond with each of the other skeletal measures. With these tables, since the five implied measures in ankle girth are already computed and may be read off opposite the respective skeletal dimensions observed, it is only necessary in addition to use those implied measures in conjunction with the actual ankle girth measure and to derive the mean value of the six values presented. The procedure of deriving the "corrected ankle girth" or the mean value of the six values in ankle girth, whether the latter are either computed or read off from Tables 3a or 3b, is one operation which cannot be provided for in tabular form. Therefore, it appears absolutely necessary that this arithmetic operation be performed in each case. As will presently be seen, however, *all* the optimal girth and diameter measurements of the body can be presented in a tabulation based on this single measure of "corrected ankle girth." If the observed skeletal dimensions are larger or smaller than those embraced by Tables 3a or 3b, it will be necessary to derive by computation each of the five implied sizes in ankle girth, using the ratios given in Table 2.

After the corrected ankle girth measure has been obtained, the girth measurements in optimal proportion thereto of the fleshy parts

TABLES 3a and 3b

TABLE FOR DERIVING PROPORTIONATE ANKLE GIRTH FROM OTHER SKELETAL DIMENSIONS

MALE

BI-ACROMIAL DIAMETER : ANKLE GIRTH					
13.5	7.39	15.2	8.32	16.9	9.25
13.55	7.41	15.25	8.34	16.95	9.27
13.6	7.44	15.3	8.37	17.0	9.30
13.65	7.47	15.35	8.40	17.05	9.33
13.7	7.49	15.4	8.42	17.1	9.35
13.75	7.52	15.45	8.45	17.15	9.38
13.8	7.55	15.5	8.48	17.2	9.41
13.85	7.57	15.55	8.51	17.25	9.44
13.9	7.60	15.6	8.53	17.3	9.46
13.95	7.63	15.65	8.56	17.35	9.49
14.0	7.66	15.7	8.59	17.4	9.52
14.05	7.69	15.75	8.62	17.45	9.55
14.1	7.71	15.8	8.64	17.5	9.57
14.15	7.74	15.85	8.67	17.55	9.60
14.2	7.77	15.9	8.70	17.6	9.63
14.25	7.80	15.96	8.73	17.65	9.66
14.3	7.82	16.0	8.75	17.7	9.68
14.35	7.85	16.05	8.78	17.75	9.71
14.4	7.88	16.1	8.81	17.8	9.74
14.45	7.90	16.15	8.83	17.85	9.76
14.5	7.93	16.2	8.86	17.9	9.79
14.55	7.96	16.25	8.89	17.95	9.82
14.6	7.99	16.3	8.92	18.0	9.85
14.65	8.01	16.35	8.94	18.05	9.87
14.7	8.04	16.4	8.97	18.1	9.90
14.75	8.07	16.45	9.00	18.15	9.93
14.8	8.10	16.5	9.03	18.2	9.96
14.85	8.12	16.55	9.05	18.25	9.98
14.9	8.15	16.6	9.08	18.3	10.01
14.95	8.18	16.65	9.11	18.35	10.04
15.0	8.21	16.7	9.14	18.4	10.07
15.05	8.23	16.75	9.16	18.45	10.09
15.1	8.26	16.8	9.19	18.5	10.12
15.15	8.29	16.85	9.22	18.55	10.15

BI-ILIAC DIAMETER : ANKLE GIRTH					
9.35	7.37	10.55	8.32	11.75	9.27
9.4	7.41	10.6	8.36	11.8	9.31
9.45	7.45	10.65	8.40	11.85	9.35
9.5	7.49	10.7	8.44	11.9	9.38
9.55	7.53	10.75	8.48	11.95	9.42
9.6	7.57	10.8	8.52	12.0	9.46
9.65	7.61	10.85	8.56	12.05	9.50
9.7	7.65	10.9	8.60	12.1	9.54
9.75	7.69	10.95	8.64	12.15	9.58
9.8	7.73	11.0	8.68	12.2	9.62
9.85	7.77	11.05	8.71	12.25	9.66
9.9	7.81	11.1	8.75	12.3	9.70
9.95	7.85	11.15	8.79	12.35	9.74
10.0	7.89	11.2	8.83	12.4	9.78
10.05	7.93	11.25	8.87	12.45	9.82
10.1	7.97	11.3	8.91	12.5	9.86
10.15	8.00	11.35	8.95	12.55	9.90
10.2	8.04	11.4	8.99	12.6	9.94
10.25	8.08	11.45	9.03	12.65	9.98
10.3	8.12	11.5	9.07	12.7	10.02
10.35	8.16	11.55	9.11	12.75	10.06
10.4	8.20	11.6	9.15	12.8	10.09
10.45	8.24	11.65	9.19	12.85	10.13
10.5	8.28	11.7	9.23	12.9	10.17

BI-TROCHANTERIC DIAMETER : ANKLE GIRTH					
10.85	7.40	12.2	8.32	13.55	9.24
10.9	7.43	12.25	8.35	13.6	9.27
10.95	7.46	12.3	8.38	13.65	9.30
11.0	7.50	12.35	8.41	13.7	9.34
11.05	7.53	12.4	8.45	13.75	9.37
11.1	7.57	12.45	8.49	13.8	9.41
11.15	7.60	12.5	8.52	13.85	9.44
11.2	7.63	12.55	8.55	13.9	9.48
11.25	7.67	12.6	8.59	13.95	9.51
11.3	7.70	12.65	8.62	14.0	9.54
11.35	7.74	12.7	8.66	14.05	9.58
11.4	7.77	12.75	8.69	14.1	9.61
11.45	7.80	12.8	8.73	14.15	9.64
11.5	7.84	12.85	8.76	14.2	9.68
11.55	7.87	12.9	8.79	14.25	8.71
11.6	7.91	12.95	8.82	14.3	9.75
11.65	7.94	13.0	8.86	14.35	9.78
11.7	7.98	13.05	8.90	14.4	9.82
11.75	8.01	13.1	8.93	14.45	9.85
11.8	8.04	13.15	8.96	14.5	9.88
11.85	8.08	13.2	9.00	14.55	9.92
11.9	8.11	13.25	9.03	14.6	9.95
11.95	8.14	13.3	9.07	14.65	9.99
12.0	8.18	13.35	9.10	14.7	10.02
12.05	8.21	13.4	9.13	14.75	10.05
12.1	8.25	13.45	9.17	14.8	10.09
12.15	8.28	13.5	9.20	14.85	10.12

WRIST GIRTH : ANKLE GIRTH			
5.95	7.39	7.1	8.82
6.0	7.45	7.15	8.88
6.05	7.52	7.2	8.95
6.1	7.58	7.25	9.01
6.15	7.64	7.3	9.07
6.2	7.70	7.35	9.13
6.25	7.76	7.4	9.19
6.3	7.83	7.45	9.25
6.35	7.89	7.5	9.32
6.4	7.95	7.55	9.38
6.45	8.01	7.6	9.44
6.5	8.07	7.65	9.50
6.55	8.14	7.7	9.57
6.6	8.20	7.75	9.63
6.65	8.26	7.8	9.69
6.7	8.32	7.85	9.75
6.75	8.39	7.9	9.81
6.8	8.45	7.95	9.88
6.85	8.51	8.0	9.94
6.9	8.57	8.05	10.00
6.95	8.63	8.1	10.06
7.0	8.70	8.15	10.12
7.05	8.76	8.2	10.19

KNEE GIRTH : ANKLE GIRTH					
12.4	7.40	13.95	8.32	15.5	9.25
12.45	7.43	14.0	8.35	15.55	9.28
12.5	7.46	14.05	8.38	15.6	9.31
12.55	7.49	14.1	8.41	15.65	9.34
12.6	7.52	14.15	8.44	15.7	9.37
12.65	7.55	14.2	8.47	15.75	9.40
12.7	7.58	14.25	8.50	15.8	9.43
12.75	7.61	14.3	8.53	15.85	9.46
12.8	7.64	14.35	8.56	15.9	9.49
12.85	7.67	14.4	8.59	15.95	9.52
12.9	7.70	14.45	8.62	16.0	9.55
12.95	7.73	14.5	8.65	16.05	9.58
13.0	7.76	14.55	8.68	16.1	9.61
13.05	7.79	14.6	8.71	16.15	9.64
13.1	7.82	14.65	8.74	16.2	9.67
13.15	7.85	14.7	8.77	16.25	9.70
13.2	7.88	14.75	8.80	16.3	9.73
13.25	7.91	14.8	8.83	16.35	9.76
13.3	7.94	14.85	8.86	16.4	9.79
13.35	7.97	14.9	8.89	16.45	9.82
13.4	8.00	14.95	8.92	16.5	9.84
13.45	8.02	15.0	8.95	16.55	9.87
13.5	8.05	15.05	8.98	16.6	9.90
13.55	8.08	15.1	9.01	16.65	9.93
13.6	8.11	15.15	9.04	16.7	9.96
13.65	8.14	15.2	9.07	16.75	9.99
13.7	8.17	15.25	9.10	16.8	10.02
13.75	8.20	15.3	9.13	16.85	10.05
13.8	8.23	15.35	9.16	16.9	10.08
13.85	8.26	15.4	9.19	16.95	10.11
13.9	8.29	15.45	9.22	17.0	10.14

FEMALE

BI-ACROMIAL DIAMETER : ANKLE GIRTH					
11.8	6.98	13.15	7.78	14.5	8.57
11.85	7.01	13.2	7.81	14.55	8.60
11.9	7.04	13.25	7.84	14.6	8.63
11.95	7.07	13.3	7.87	14.65	8.66
12.0	7.10	13.35	7.89	14.7	8.69
12.05	7.13	13.4	7.92	14.75	8.72
12.1	7.16	13.45	7.95	14.8	8.75
12.15	7.19	13.5	7.98	14.85	8.78
12.2	7.21	13.55	8.01	14.9	8.81
12.25	7.24	13.6	8.04	14.95	8.84
12.3	7.27	13.65	8.07	15.0	8.87
12.35	7.30	13.7	8.10	15.05	8.90
12.4	7.33	13.75	8.13	15.1	8.93
12.45	7.36	13.8	8.16	15.15	8.96
12.5	7.39	13.85	8.19	15.2	8.99
12.55	7.42	13.9	8.22	15.25	9.02
12.6	7.45	13.95	8.25	15.3	9.05
12.65	7.48	14.0	8.28	15.35	9.08
12.7	7.51	14.05	8.31	15.4	9.11
12.75	7.54	14.1	8.34	15.45	9.14
12.8	7.57	14.15	8.37	15.5	9.17
12.85	7.60	14.2	8.40	15.55	9.20
12.9	7.63	14.25	8.43	15.6	9.23
12.95	7.66	14.3	8.46	15.65	9.25
13.0	7.69	14.35	8.49	15.7	9.28
13.05	7.72	14.4	8.52	15.75	9.31
13.1	7.75	14.45	8.55	15.8	9.34

BI-ILIAC DIAMETER - ANKLE GIRTH					
9.35	6.97	10.45	7.79	11.55	8.61
9.4	7.01	10.5	7.83	11.6	8.65
9.45	7.05	10.55	7.87	11.65	8.69
9.5	7.08	10.6	7.90	11.7	8.72
9.55	7.12	10.65	7.94	11.75	8.76
9.6	7.16	10.7	7.98	11.8	8.80
9.65	7.20	10.75	8.02	11.85	8.84
9.7	7.23	10.8	8.05	11.9	8.87
9.75	7.27	10.85	8.09	11.95	8.91
9.8	7.31	10.9	8.13	12.0	8.95
9.85	7.35	10.95	8.17	12.05	8.99
9.9	7.38	11.0	8.20	12.1	9.02
9.95	7.42	11.05	8.24	12.15	9.06
10.0	7.46	11.1	8.28	12.2	9.10
10.05	7.49	11.15	8.31	12.25	9.13
10.1	7.53	11.2	8.35	12.3	9.17
10.15	7.57	11.25	8.39	12.35	9.21
10.2	7.61	11.3	8.43	12.4	9.25
10.25	7.64	11.35	8.46	12.45	9.28
10.3	7.68	11.4	8.50	12.5	9.32
10.35	7.72	11.45	8.54	12.55	9.36
10.4	7.76	11.5	8.57	12.6	9.40

BI-TROCHANTERIC DIAMETER - ANKLE GIRTH					
10.55	6.98	11.75	7.78	12.95	8.57
10.6	7.02	11.8	7.81	13.0	8.60
10.65	7.05	11.85	7.84	13.05	8.64
10.7	7.08	11.9	7.88	13.1	8.67
10.75	7.11	11.95	7.91	13.15	8.70
10.8	7.14	12.0	7.94	13.2	8.74
10.85	7.18	12.05	7.97	13.25	8.77
10.9	7.21	12.1	8.01	13.3	8.80
10.95	7.25	12.15	8.04	13.35	8.84
11.0	7.28	12.2	8.07	13.4	8.87
11.05	7.31	12.25	8.11	13.45	8.90
11.1	7.34	12.3	8.14	13.5	8.93
11.15	7.38	12.35	8.17	13.55	8.97
11.2	7.41	12.4	8.21	13.6	9.00
11.25	7.45	12.45	8.24	13.65	9.03
11.3	7.48	12.5	8.27	13.7	9.07
11.35	7.51	12.55	8.31	13.75	9.10
11.4	7.54	12.6	8.34	13.8	9.13
11.45	7.58	12.65	8.37	13.85	9.17
11.5	7.61	12.7	8.41	13.9	9.20
11.55	7.64	12.75	8.44	13.95	9.23
11.6	7.68	12.8	8.47	14.0	9.27
11.65	7.71	12.85	8.50	14.05	9.30
11.7	7.74	12.9	8.54	14.1	9.33

WRIST GIRTH ANKLE GIRTH			
5.15	6.96	6.05	8.17
5.2	7.02	6.1	8.24
5.25	7.09	6.15	8.31
5.3	7.16	6.2	8.37
5.35	7.23	6.25	8.44
5.4	7.29	6.3	8.51
5.45	7.36	6.35	8.58
5.5	7.43	6.4	8.65
5.55	7.50	6.45	8.71
5.6	7.56	6.5	8.78
5.65	7.63	6.55	8.85
5.7	7.70	6.6	8.92
5.75	7.77	6.65	8.98
5.8	7.83	6.7	9.05
5.85	7.90	6.75	9.12
5.9	7.97	6.8	9.19
5.95	8.04	6.85	9.25
6.0	8.10	6.9	9.32

KNEE GIRTH : ANKLE GIRTH					
11.85	6.99	13.2	7.79	14.55	8.58
11.9	7.02	13.25	7.82	14.6	8.61
11.95	7.05	13.3	7.85	14.65	8.64
12.0	7.08	13.35	7.88	14.7	8.67
12.05	7.11	13.4	7.91	14.75	8.70
12.1	7.14	13.45	7.94	14.8	8.73
12.15	7.17	13.5	7.96	14.85	8.76
12.2	7.20	13.55	7.99	14.9	8.79
12.25	7.23	13.6	8.02	14.95	8.82
12.3	7.26	13.65	8.05	15.0	8.85
12.35	7.29	13.7	8.08	1905	8.38
12.4	7.32	13.75	8.11	15.1	8.91
12.45	7.35	13.8	8.14	15.15	8.94
12.5	7.37	13.85	8.17	15.2	8.97
12.55	7.40	13.9	8.20	15.25	9.00
12.6	7.43	13.95	8.23	15.3	9.03
12.65	7.46	14.0	8.26	15.35	9.06
12.7	7.49	14.05	8.29	154	9.09
12.75	7.52	14.1	8.32	1545	9.12
12.8	7.55	14.15	8.35	15.5	9.14
12.85	7.58	14.2	8.38	1555	9.17
12.9	7.61	14.25	8.41	15.6	9.20
12.95	7.64	14.3	8.44	15.65	9.23
13.0	7.67	14.35	8.47	15.7	9.26
13.05	7.70	14.4	8.50	15.75	9.29
13.1	7.73	14.45	8.53	15.8	9.32
13.15	7.76	14.5	8.55	15.85	9.35

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of the body are established by multiplying the corrected ankle girth by the respective ratios given in Table 4. (For determining the *skeletal* measurements in optimal proportion to the corrected ankle girth, the same procedure of multiplying is employed, using the ratios given in Table 2. This reciprocal use of the corrected ankle girth affords a valuable means of comparing the actual skeletal conformation of a subject with the conformation prescribed as optimal.)

TABLE 4

OPTIMAL RELATIONSHIP IN SIZE OF FLESHY MEASUREMENTS TO CORRECTED ANKLE GIRTH

Male		*Female*
1.802	Girth of Neck	1.547
1.681	Girth of Flexed Upper Arm	1.364
1.405	Girth of Forearm	1.168
2.200	Breadth of Shoulders (bi-deltoid)	1.987
4.695	Girth of Chest (normal)	4.065
3.522	Girth of Waist	3.176
4.260	Girth of Hips	4.537
2.539	Girth of Thigh	2.665
1.693	Girth of Calf	1.647
1.000	Corrected Ankle Girth	1.000

The optimal body weight, to correspond with a given list of prescribed girth measurements, is arrived at by *squaring* the corrected ankle girth measure, multiplying the squared value by the observed measure in stature, and dividing the product by the constant 31.88 male or 34.67 female, (i.e., letting "A" equal the corrected ankle girth in inches, "S" the stature in inches, and "C" the constant just given, Optimal Body Weight in pounds $= \frac{A^2S}{C}$).

Tables 5a and 5b, "Optimal Proportions of the Body in relation to Corrected Ankle Girth," designed to obviate unnecessary computation, incorporate the ratios specified in Table 2 and Table 4 and the equation for converting girth measures and stature into body weight.

The respective "constants" (31.88 male and 34.67 female) for converting corrected ankle girth times stature (or relative "volume") into body weight, are derived from a computation involving the stature and eighteen girth measurements of the body. These girth measurements are: Neck, Flexed Upper Arm (right), Flexed Upper Arm (left), Forearm (right), Forearm (left), Wrist (right), Wrist (left), Chest (normal), Waist, Hips, Thigh (right), Thigh (left), Knee (right), Knee (left), Calf (right), Calf (left), Ankle (right), Ankle (left). Each girth measurement is squared (separately), the

TABLE 5a

OPTIMUM PROPORTIONS of the BODY in relation to "CORRECTED" ANKLE GIRTH

MALE (Adult)

Corrected Ankle Girth, inches	Skeletal measurements, inches												Fleshy measurements, inches												Body weight, Pounds per inch of height
	Diameters					Girths							Diam	Girths											
	Bi-acromial	Chest Trans	Chest Ant.-post.	Bi-iliac	Bi-trochant.	Wrist R	Wrist L	Knee R	Knee L	Ankle R	Ankle L		Bi-deltoid	Neck	Upper arm, flexed R	Upper arm, flexed L	Forearm R	Forearm L	Chest normal	Waist	Hips	Thigh R	Thigh L	Calf R	Calf L	
7.4	13.5	10.0	7.0	9.4	10.9	6.0	6.0	12.4	12.4	—	—		16.3	13.5	12.4	12.4	10.4	10.4	34.7	26.1	31.5	18.8	18.8	12.5	12.5	1.720
7.45	13.6	10.1	7.0	9.4	10.9	6.0	6.0	12.5	12.5	—	—		16.4	13.4	12.5	12.5	10.5	10.5	35.0	26.2	31.7	18.9	18.9	12.6	12.6	1.743
7.5	13.7	10.2	7.0	9.5	11.0	6.0	6.0	12.6	12.6	—	—		16.5	13.5	12.6	12.6	10.5	10.5	35.2	26.4	31.9	19.0	19.0	12.7	12.7	1.766
7.55	13.8	10.2	7.1	9.6	11.1	6.1	6.1	12.7	12.7	—	—		16.6	13.6	12.7	12.7	10.6	10.6	35.4	26.6	32.2	19.2	19.2	12.8	12.8	1.789
7.6	13.9	10.3	7.1	9.6	11.1	6.1	6.1	12.7	12.7	—	—		16.7	13.7	12.8	12.8	10.7	10.7	35.7	26.8	32.4	19.3	19.3	12.9	12.9	1.812
7.65	14.0	10.4	7.2	9.7	11.2	6.2	6.2	12.8	12.8	—	—		16.8	13.8	12.9	12.9	10.7	10.7	35.9	26.9	32.6	19.4	19.4	13.0	13.0	1.836
7.7	14.1	10.4	7.2	9.8	11.3	6.2	6.2	12.9	12.9	—	—		16.9	13.9	12.9	12.9	10.8	10.8	36.2	27.1	32.8	19.6	19.6	13.0	13.0	1.860
7.75	14.2	10.5	7.3	9.8	11.4	6.2	6.2	13.0	13.0	—	—		17.0	14.0	13.0	13.0	10.9	10.9	36.4	27.3	33.0	19.7	19.7	13.1	13.1	1.884
7.8	14.3	10.6	7.3	9.9	11.4	6.3	6.3	13.1	13.1	—	—		17.2	14.1	13.1	13.1	11.0	11.0	36.6	27.5	33.2	19.8	19.8	13.2	13.2	1.908
7.85	14.3	10.7	7.4	10.0	11.5	6.3	6.3	13.2	13.2	—	—		17.3	14.1	13.2	13.2	11.0	11.0	36.9	27.6	33.4	19.9	19.9	13.3	13.3	1.933
7.9	14.4	10.7	7.4	10.0	11.6	6.4	6.4	13.2	13.2	—	—		17.4	14.2	13.3	13.3	11.1	11.1	37.1	27.8	33.7	20.1	20.1	13.4	13.4	1.958
7.95	14.5	10.8	7.5	10.1	11.7	6.4	6.4	13.3	13.3	—	—		17.5	14.3	13.4	13.4	11.2	11.2	37.3	28.0	33.9	20.2	20.2	13.5	13.5	1.983
8.0	14.6	10.9	7.5	10.1	11.7	6.4	6.4	13.4	13.4	—	—		17.6	14.4	13.4	13.4	11.2	11.2	37.6	28.2	34.1	20.3	20.3	13.5	13.5	2.008
8.05	14.7	10.9	7.6	10.2	11.8	6.5	6.5	13.5	13.5	—	—		17.7	14.5	13.5	13.5	11.3	11.3	37.8	28.4	34.3	20.4	20.4	13.6	13.6	2.033
8.1	14.8	11.0	7.6	10.3	11.9	6.5	6.5	13.6	13.6	—	—		17.8	14.6	13.6	13.6	11.4	11.4	38.0	28.5	34.5	20.6	20.6	13.7	13.7	2.058
8.15	14.9	11.1	7.7	10.3	12.0	6.6	6.6	13.7	13.7	—	—		17.9	14.7	13.7	13.7	11.5	11.5	38.3	28.7	34.7	20.7	20.7	13.8	13.8	2.084
8.2	15.0	11.1	7.7	10.4	12.0	6.6	6.6	13.7	13.7	—	—		18.0	14.8	13.8	13.8	11.5	11.5	38.5	28.9	34.9	20.8	20.8	13.9	13.9	2.109
8.25	15.1	11.2	7.8	10.5	12.1	6.6	6.6	13.8	13.8	—	—		18.1	14.9	13.9	13.9	11.6	11.6	38.7	29.1	35.2	20.9	20.9	14.0	14.0	2.135
8.3	15.2	11.3	7.8	10.5	12.2	6.7	6.7	13.9	13.9	—	—		18.3	15.0	14.0	14.0	11.7	11.7	39.0	29.2	35.4	21.1	21.1	14.1	14.1	2.161
8.35	15.3	11.3	7.8	10.6	12.2	6.7	6.7	14.0	14.0	—	—		18.4	15.0	14.0	14.0	11.7	11.7	39.2	29.4	35.6	21.2	21.2	14.1	14.1	2.187
8.4	15.3	11.4	7.9	10.7	12.3	6.8	6.8	14.1	14.1	—	—		18.5	15.1	14.1	14.1	11.8	11.8	39.4	29.6	35.8	21.3	21.3	14.2	14.2	2.213
8.45	15.4	11.5	7.9	10.7	12.4	6.8	6.8	14.2	14.2	—	—		18.6	15.2	14.2	14.2	11.9	11.9	39.7	29.8	36.0	21.5	21.5	14.3	14.3	2.239
8.5	15.5	11.5	8.0	10.8	12.5	6.8	6.8	14.2	14.2	—	—		18.7	15.3	14.3	14.3	11.9	11.9	39.9	29.9	36.2	21.6	21.6	14.4	14.4	2.266
8.55	15.6	11.6	8.0	10.8	12.5	6.9	6.9	14.3	14.3	—	—		18.8	15.4	14.4	14.4	12.0	12.0	40.1	30.1	36.4	21.7	21.7	14.5	14.5	2.293
8.6	15.7	11.7	8.1	10.9	12.6	6.9	6.9	14.4	14.4	—	—		18.9	15.5	14.5	14.5	12.1	12.1	40.4	30.3	36.6	21.8	21.8	14.6	14.6	2.320
8.65	15.8	11.7	8.1	11.0	12.7	7.0	7.0	14.5	14.5	—	—		19.0	15.6	14.5	14.5	12.2	12.2	40.6	30.6	36.9	22.0	22.0	14.6	14.6	2.347
8.7	15.9	11.8	8.2	11.0	12.8	7.0	7.0	14.6	14.6	—	—		19.1	15.7	14.6	14.6	12.2	12.2	40.8	30.9	37.1	22.1	22.1	14.7	14.7	2.376
8.75	16.0	11.9	8.2	11.1	12.8	7.0	7.0	14.7	14.7	—	—		19.2	15.8	14.7	14.7	12.3	12.3	41.1	30.8	37.3	22.2	22.2	14.8	14.8	2.401
8.8	16.1	12.0	8.3	11.2	12.9	7.1	7.1	14.7	14.7	—	—		19.4	15.9	14.8	14.8	12.4	12.4	41.3	31.0	37.5	22.3	22.3	14.9	14.9	2.429
8.85	16.2	12.0	8.3	11.2	13.0	7.1	7.1	14.8	14.8	—	—		19.5	15.9	14.9	14.9	12.4	12.4	41.6	31.2	37.7	22.5	22.5	15.0	15.0	2.457
8.9	16.3	12.1	8.4	11.3	13.1	7.2	7.2	14.9	14.9	—	—		19.6	16.0	15.0	15.0	12.5	12.5	41.8	31.3	37.9	22.6	22.6	15.1	15.1	2.488
8.95	16.3	12.2	8.4	11.4	13.1	7.2	7.2	15.0	15.0	—	—		19.7	16.1	15.0	15.0	12.6	12.6	42.0	31.5	38.1	22.7	22.7	15.1	15.1	2.513
9.0	16.4	12.2	8.5	11.4	13.2	7.2	7.2	15.1	15.1	—	—		19.8	16.2	15.1	15.1	12.6	12.6	42.3	31.7	38.3	22.9	22.9	15.2	15.2	2.541
9.05	16.5	12.3	8.5	11.5	13.3	7.3	7.3	15.2	15.2	—	—		19.9	16.3	15.2	15.2	12.7	12.7	42.5	31.9	38.6	23.0	23.0	15.3	15.3	2.569
9.1	16.6	12.4	8.6	11.5	13.3	7.3	7.3	15.3	15.3	—	—		20.0	16.4	15.3	15.3	12.8	12.8	42.7	32.0	38.8	23.1	23.1	15.4	15.4	2.597
9.15	16.7	12.4	8.6	11.6	13.4	7.4	7.4	15.3	15.3	—	—		20.1	16.5	15.4	15.4	12.9	12.9	43.0	32.2	39.0	23.2	23.2	15.5	15.5	2.626
9.2	16.8	12.5	8.6	11.7	13.5	7.4	7.4	15.4	15.4	—	—		20.2	16.6	15.5	15.5	12.9	12.9	43.2	32.4	39.2	23.4	23.4	15.6	15.6	2.655
9.25	16.9	12.6	8.7	11.7	13.6	7.4	7.4	15.5	15.5	—	—		20.3	16.7	15.5	15.5	13.0	13.0	43.4	32.6	39.4	23.5	23.5	15.7	15.7	2.684
9.3	17.0	12.6	8.7	11.8	13.6	7.5	7.5	15.6	15.6	—	—		20.5	16.8	15.6	15.6	13.1	13.1	43.7	32.8	39.6	23.6	23.6	15.7	15.7	2.713
9.35	17.1	12.7	8.8	11.9	13.7	7.5	7.5	15.7	15.7	—	—		20.6	16.8	15.7	15.7	13.1	13.1	43.9	32.9	39.8	23.7	23.7	15.8	15.8	2.742
9.4	17.2	12.8	8.8	11.9	13.8	7.6	7.6	15.8	15.8	—	—		20.7	16.9	15.8	15.8	13.2	13.2	44.1	33.1	40.0	23.9	23.9	15.9	15.9	2.772
9.45	17.3	12.8	8.9	12.0	13.9	7.6	7.6	15.8	15.8	—	—		20.8	17.0	15.9	15.9	13.3	13.3	44.4	33.3	40.3	24.0	24.0	16.0	16.0	2.801
9.5	17.4	12.9	8.9	12.0	13.9	7.6	7.6	15.9	15.9	—	—		20.9	17.1	16.0	16.0	13.3	13.3	44.6	33.5	40.5	24.1	24.1	16.1	16.1	2.831
9.55	17.4	13.0	9.0	12.1	14.0	7.7	7.7	16.0	16.0	—	—		21.0	17.2	16.1	16.1	13.4	13.4	44.8	33.6	40.7	24.2	24.2	16.2	16.2	2.861
9.6	17.5	13.0	9.0	12.2	14.1	7.7	7.7	16.1	16.1	—	—		21.1	17.3	16.1	16.1	13.5	13.5	45.1	33.8	40.9	24.4	24.4	16.3	16.3	2.891
9.65	17.6	13.1	9.1	12.2	14.2	7.8	7.8	16.2	16.2	—	—		21.2	17.4	16.2	16.2	13.6	13.6	45.3	34.0	41.1	24.5	24.5	16.3	16.3	2.921
9.7	17.7	13.2	9.1	12.3	14.2	7.8	7.8	16.3	16.3	—	—		21.3	17.5	16.3	16.3	13.6	13.6	45.5	34.2	41.3	24.6	24.6	16.4	16.4	2.951
9.75	17.8	13.2	9.2	12.4	14.3	7.8	7.8	16.3	16.3	—	—		21.4	17.6	16.4	16.4	13.7	13.7	45.8	34.3	41.5	24.8	24.8	16.5	16.5	2.981
9.8	17.9	13.3	9.2	12.4	14.4	7.9	7.9	16.4	16.4	—	—		21.6	17.7	16.5	16.5	13.8	13.8	46.0	34.5	41.7	24.9	24.9	16.6	16.6	3.012
9.85	18.0	13.4	9.3	12.5	14.4	7.9	7.9	16.5	16.5	—	—		21.7	17.7	16.6	16.6	13.8	13.8	46.2	34.7	42.0	25.0	25.0	16.7	16.7	3.043
9.9	18.1	13.4	9.3	12.5	14.5	8.0	8.0	16.6	16.6	—	—		21.8	17.8	16.6	16.6	13.9	13.9	46.5	34.9	42.2	25.1	25.1	16.8	16.8	3.074
9.95	18.2	13.5	9.4	12.6	14.6	8.0	8.0	16.7	16.7	—	—		21.9	17.9	16.7	16.7	14.0	14.0	46.7	35.1	42.4	25.3	25.3	16.8	16.8	3.105
10.0	18.3	13.6	9.4	12.7	14.7	8.0	8.0	16.8	16.8	—	—		22.0	18.0	16.8	16.8	14.0	14.0	46.9	35.2	42.6	25.4	25.4	16.9	16.9	3.136
10.05	18.4	13.6	9.4	12.7	14.7	8.1	8.1	16.8	16.8	—	—		22.1	18.1	16.9	16.9	14.1	14.1	47.2	35.4	42.8	25.5	25.5	17.0	17.0	3.167
10.1	18.5	13.7	9.5	12.8	14.8	8.1	8.1	16.9	16.9	—	—		22.2	18.2	17.0	17.0	14.2	14.2	47.4	35.6	43.0	25.6	25.6	17.1	17.1	3.199
10.15	18.5	13.8	9.5	12.9	14.9	8.2	8.2	17.0	17.0	—	—		22.3	18.3	17.1	17.1	14.3	14.3	47.7	35.7	43.3	25.8	25.8	17.2	17.2	3.231
10.2	18.6	13.9	9.6	12.9	15.0	8.2	8.2	17.1	17.1	—	—		22.4	18.4	17.1	17.1	14.3	14.3	47.9	35.9	43.5	25.9	25.9	17.3	17.3	3.263

TABLE 5b

FEMALE (Adult)

Corrected Ankle Girth, inches	Skeletal measurements, inches												Fleshy measurements, inches												Body weight, pounds, per inch of height
	Diameters					Girths							Diam	Girths											
	Bi-acromial	Chest Trans.	Chest Ant.-post.	Bi-iliac	Bi-trochanteric	Wrist R.	Wrist L.	Knee R.	Knee L.	Ankle* R.	Ankle* L.		Bi-deltoid	Neck	Upper arm, flexed R.	Upper arm, flexed L.	Forearm R.	Forearm L.	Chest, normal	Waist	Hips	Thigh R.	Thigh L.	Calf R.	Calf L.	
7.0	11.8	9.2	6.2	9.4	10.6	5.2	5.2	11.9	11.9	—	—		15.9	10.8	9.6	9.5	8.2	8.2	28.5	22.2	31.8	18.7	18.7	11.5	11.5	1.415
7.05	11.9	9.2	6.2	9.5	10.7	5.2	5.2	11.9	11.9	—	—		16.0	10.9	9.6	9.6	8.2	8.2	28.7	22.4	32.0	18.8	18.8	11.6	11.6	1.435
7.1	12.0	9.3	6.3	9.5	10.7	5.3	5.3	12.0	12.0	—	—		16.1	11.0	9.7	9.7	8.3	8.3	28.9	22.5	32.2	18.9	18.9	11.7	11.7	1.455
7.15	12.1	9.4	6.3	9.6	10.8	5.3	5.3	12.1	12.1	—	—		16.2	11.1	9.8	9.8	8.3	8.3	29.1	22.7	32.4	19.1	19.1	11.8	11.8	1.474
7.2	12.2	9.5	6.4	9.7	10.9	5.3	5.3	12.2	12.2	—	—		16.3	11.1	9.8	9.8	8.4	8.4	29.3	22.9	32.7	19.2	19.2	11.9	11.9	1.495
7.25	12.3	9.5	6.4	9.7	11.0	5.4	5.4	12.3	12.3	—	—		16.4	11.2	9.9	9.9	8.5	8.5	29.5	23.0	32.9	19.3	19.3	11.9	11.9	1.516
7.3	12.3	9.6	6.4	9.8	11.0	5.4	5.4	12.4	12.4	—	—		16.5	11.3	10.0	10.0	8.5	8.5	29.7	23.2	33.1	19.5	19.5	12.0	12.0	1.537
7.35	12.4	9.7	6.5	9.9	11.1	5.4	5.4	12.5	12.5	—	—		16.6	11.4	10.0	10.0	8.6	8.6	29.9	23.3	33.3	19.6	19.6	12.1	12.1	1.558
7.4	12.5	9.7	6.5	9.9	11.2	5.5	5.5	12.5	12.5	—	—		16.7	11.4	10.1	10.1	8.6	8.6	30.1	23.5	33.6	19.7	19.7	12.2	12.2	1.579
7.45	12.6	9.8	6.6	10.0	11.3	5.5	5.5	12.6	12.6	—	—		16.8	11.5	10.2	10.2	8.7	8.7	30.3	23.7	33.8	19.9	19.9	12.3	12.3	1.600
7.5	12.7	9.8	6.6	10.1	11.3	5.6	5.6	12.7	12.7	—	—		16.9	11.6	10.2	10.2	8.8	8.8	30.5	23.8	34.0	20.0	20.0	12.4	12.4	1.622
7.55	12.8	9.9	6.7	10.1	11.4	5.6	5.6	12.8	12.8	—	—		17.0	11.7	10.3	10.3	8.8	8.8	30.7	24.0	34.3	20.1	20.1	12.4	12.4	1.644
7.6	12.9	10.0	6.7	10.2	11.5	5.6	5.6	12.9	12.9	—	—		17.1	11.8	10.4	10.4	8.9	8.9	30.9	24.1	34.5	20.3	20.3	12.5	12.5	1.666
7.65	12.9	10.1	6.8	10.3	11.6	5.7	5.7	13.0	13.0	—	—		17.2	11.8	10.4	10.4	8.9	8.9	31.1	24.3	34.7	20.4	20.4	12.6	12.6	1.688
7.7	13.0	10.1	6.8	10.3	11.6	5.7	5.7	13.1	13.1	—	—		17.3	11.9	10.5	10.5	9.0	9.0	31.3	24.5	34.9	20.5	20.5	12.7	12.7	1.710
7.75	13.1	10.2	6.8	10.4	11.7	5.7	5.7	13.1	13.1	—	—		17.4	12.0	10.6	10.6	9.1	9.1	31.5	24.6	35.2	20.7	20.7	12.8	12.8	1.732
7.8	13.2	10.2	6.9	10.5	11.8	5.8	5.8	13.2	13.2	—	—		17.5	12.1	10.6	10.6	9.1	9.1	31.7	24.8	35.4	20.8	20.8	12.8	12.8	1.754
7.85	13.3	10.3	6.9	10.5	11.9	5.8	5.8	13.3	13.3	—	—		17.6	12.1	10.7	10.7	9.2	9.2	31.9	24.9	35.6	20.9	20.9	12.9	12.9	1.777
7.9	13.4	10.4	7.0	10.6	11.9	5.8	5.8	13.4	13.4	—	—		17.7	12.2	10.8	10.8	9.2	9.2	32.1	25.1	35.8	21.1	21.1	13.0	13.0	1.800
7.95	13.4	10.4	7.0	10.7	12.0	5.9	5.9	13.5	13.5	—	—		17.8	12.3	10.8	10.8	9.3	9.3	32.3	25.2	36.1	21.2	21.2	13.1	13.1	1.823
8.0	13.5	10.5	7.1	10.7	12.1	5.9	5.9	13.6	13.6	—	—		17.9	12.4	10.9	10.9	9.3	9.3	32.5	25.4	36.3	21.3	21.3	13.2	13.2	1.846
8.05	13.6	10.6	7.1	10.8	12.2	6.0	6.0	13.6	13.6	—	—		18.0	12.5	11.0	11.0	9.4	9.4	32.7	25.6	36.5	21.5	21.5	13.3	13.3	1.869
8.1	13.7	10.6	7.1	10.9	12.2	6.0	6.0	13.7	13.7	—	—		18.1	12.5	11.0	11.0	9.5	9.5	32.9	25.7	36.7	21.6	21.6	13.5	13.3	1.892
8.15	13.8	10.7	7.2	10.9	12.3	6.0	6.0	13.8	13.8	—	—		18.2	12.6	11.1	11.1	9.5	9.5	33.1	25.9	37.0	21.7	21.7	13.4	13.4	1.915
8.2	13.9	10.8	7.2	11.0	12.4	6.1	6.1	13.9	13.9	—	—		18.3	12.7	11.2	11.2	9.6	9.6	33.3	26.0	37.2	21.9	21.9	13.5	13.5	1.939
8.25	14.0	10.8	7.3	11.1	12.5	6.1	6.1	14.0	14.0	—	—		18.4	12.8	11.3	11.3	9.6	9.6	33.5	26.2	37.5	22.0	22.0	13.6	13.6	1.963
8.3	14.0	10.9	7.3	11.1	12.5	6.1	6.1	14.1	14.1	—	—		18.5	12.8	11.3	11.3	9.7	9.7	33.7	26.4	37.7	22.1	22.1	13.7	13.7	1.987
8.35	14.1	11.0	7.4	11.2	12.6	6.2	6.2	14.2	14.2	—	—		18.6	12.9	11.4	11.4	9.8	9.8	33.9	26.5	37.9	22.3	22.3	13.8	13.8	2.011
8.4	14.2	11.0	7.4	11.3	12.7	6.2	6.2	14.2	14.2	—	—		18.7	13.0	11.5	11.5	9.8	9.8	34.1	26.7	38.1	22.4	22.4	13.8	13.8	2.035
8.45	14.3	11.1	7.5	11.3	12.8	6.3	6.3	14.3	14.3	—	—		18.8	13.1	11.5	11.5	9.9	9.9	34.3	26.8	38.3	22.5	22.5	13.9	13.9	2.059
8.5	14.4	11.2	7.5	11.4	12.8	6.3	6.3	14.4	14.4	—	—		18.9	13.1	11.6	11.6	9.9	9.9	34.6	27.0	38.6	22.7	22.7	14.0	14.0	2.083
8.55	14.5	11.2	7.5	11.5	12.9	6.3	6.3	14.5	14.5	—	—		17.0	13.2	11.7	11.7	10.0	10.0	34.8	27.2	38.8	22.8	22.8	14.1	14.1	2.108
8.6	14.5	11.3	7.6	11.5	13.0	6.4	6.4	14.6	14.6	—	—		17.1	13.3	11.7	11.7	10.0	10.0	35.0	27.5	39.0	22.9	22.9	14.2	14.2	2.133
8.65	14.6	11.4	7.6	11.6	13.1	6.4	6.4	14.7	14.7	—	—		17.2	13.4	11.8	11.8	10.1	10.1	35.2	27.5	39.2	23.1	23.1	14.2	14.2	2.158
8.7	14.7	11.4	7.7	11.7	13.1	6.4	6.4	14.7	14.7	—	—		17.3	13.5	11.9	11.9	10.2	10.2	35.4	27.6	39.5	23.2	23.2	14.3	14.3	2.183
8.75	14.8	11.5	7.7	11.7	13.2	6.5	6.5	14.8	14.8	—	—		17.4	13.5	11.9	11.9	10.2	10.2	35.6	27.8	39.7	23.3	23.3	14.4	14.4	2.208
8.8	14.9	11.6	7.8	11.8	13.3	6.5	6.5	14.9	14.9	—	—		17.5	13.6	12.0	12.0	10.3	10.3	35.8	27.9	39.9	23.5	23.5	14.5	14.5	2.233
8.85	15.0	11.6	7.8	11.9	13.4	6.6	6.6	15.0	15.0	—	—		17.6	13.7	12.1	12.1	10.3	10.3	36.0	28.1	40.2	23.6	23.6	14.6	14.6	2.258
8.9	15.0	11.7	7.9	11.9	13.4	6.6	6.6	15.1	15.1	—	—		17.7	13.8	12.1	12.1	10.4	10.4	36.2	28.3	40.4	23.7	23.7	14.7	14.7	2.284
8.95	15.1	11.8	7.9	12.0	13.5	6.6	6.6	15.2	15.2	—	—		17.8	13.8	12.2	12.2	10.5	10.5	36.4	28.4	40.6	23.8	23.9	14.7	14.7	2.310
9.0	15.2	11.8	7.9	12.1	13.6	6.7	6.7	15.3	15.3	—	—		17.9	13.9	12.3	12.3	10.5	10.5	36.6	28.6	40.8	24.0	24.0	14.8	14.8	2.336
9.05	15.3	11.9	8.0	12.1	13.7	6.7	6.7	15.3	15.3	—	—		18.0	14.0	12.3	12.3	10.6	10.6	36.8	28.7	41.1	24.1	24.1	14.9	14.9	2.362
9.1	15.4	11.9	8.0	12.2	13.8	6.7	6.7	15.4	15.4	—	—		18.1	14.1	12.4	12.4	10.6	10.6	37.0	28.9	41.3	24.3	24.3	15.0	15.0	2.388
9.15	15.5	12.0	8.1	12.3	13.8	6.8	6.8	15.5	15.5	—	—		18.2	14.2	12.5	12.5	10.7	10.7	37.2	29.1	41.5	24.4	24.4	15.1	15.1	2.414
9.2	15.6	12.1	8.1	12.3	13.9	6.8	6.8	15.6	15.6	—	—		18.3	14.2	12.5	12.5	10.7	10.7	37.4	29.2	41.7	24.5	24.5	15.2	15.2	2.441
9.25	15.6	12.1	8.2	12.4	14.0	6.8	6.8	15.7	15.7	—	—		18.4	14.3	12.6	12.6	10.8	10.8	37.6	29.4	42.0	24.7	24.7	15.2	15.2	2.468
9.3	15.7	12.2	8.2	12.5	14.1	6.9	6.9	15.8	15.8	—	—		18.5	14.4	12.7	12.7	10.9	10.9	37.8	29.5	42.2	24.8	24.8	15.3	15.3	2.495
9.35	15.8	12.3	8.3	12.5	14.1	6.9	6.9	15.8	15.8	—	—		18.6	14.5	12.8	12.8	10.9	10.9	38.0	29.7	42.4	24.9	24.9	15.4	15.4	2.522
9.4	15.9	12.3	8.3	12.6	14.2	7.0	7.0	15.9	15.9	—	—		18.7	14.5	12.8	12.8	11.0	11.0	38.2	29.9	42.6	25.1	25.1	15.5	15.5	2.549

* Same as 'corrected' ankle girth

squared values added, the added values multiplied by the stature, and the total divided by the observed body weight. The mean divisor found by this procedure is 2964 male and 2930 female. The extreme individual values presented among 50 male subjects are respectively 2882 and 3081; among 20 female subjects, 2845 and 3068.

The last-specified "constants" are not actually constant in application to all persons, for the reason that many factors combine to result in variability of body weight for a given "volume" of the body as represented by the foregoing method of approximation. For the sake of practicality, we here limit the scope of our formulae to the two chief considerations of stature and sum-total of squared girth measurements. Over and above these considerations, body weight is influenced by the respective length of the trunk and limbs for a given stature, relative distribution of the bulk of the body as regards the respective magnitude of the various girth measurements, relative horizontal cross-sectional outline of the trunk (whether broad and shallow or narrow and deep), general density of the body (principally the balance between muscular and fatty tissue), and perhaps other minor influences. We cannot here go into detail regarding this involved subject. Suffice it to state that the body weight computed from observed girth measurements and stature may in individual cases vary as much as 4 per cent above or below the amount expected. Consequently, our formula based on typical relationships may in its application err to the same degree. That is, if a person's optimal body weight is computed as 150 pounds, that person might actually weigh any amount between 144 pounds and 156 pounds and still possess the girth dimensions prescribed. In a majority of instances, however, the difference between actual and expected body weight will not amount to more than 2 per cent.

NOW, after considerable explanation of principles, all of which we trust was essential to a clear understanding of the subject concerned, the point has been reached where an example may be adduced to show how the optimal girth dimensions and body weight, to apply to the observed dimensions in stature and skeletal thickness, are arrived at. The subject (male) has the following measurements (in inches): stature 69.0, girth of ankle (average of right and left) 8.5, girth of wrist (average of right and left) 6.8, girth of knee (average of right and left) 14.3, bi-acromial diameter 15.4, bi-iliac diameter 11.4, bi-trochanteric diameter 13.1.

Listing the actual ankle girth measure as 8.50, the additional implied values in ankle girth are read off from Table 3a as: from bi-acromial diameter, 8.42; from bi-iliac diameter, 8.99; from bi-trochanteric diameter, 8.93; from wrist girth, 8.45; from knee girth, 8.53. Listing these respective ankle girth measures from lowest to

highest, and obtaining the mean value of the six values by the "weighted average" method previously described we have:

$$\begin{array}{r} 8.42 \times 1 = \ 8.42 \\ 8.45 \times 2 = 16.90 \\ 8.50 \times 3 = 25.50 \\ 8.53 \times 3 = 25.59 \\ 8.93 \times 2 = 17.86 \\ 8.99 \times 1 = \ 8.99 \\ \hline 12 \mid 103.26 \\ \hline 8.60+ \end{array}$$

That is, the "corrected ankle girth" of the subject here taken as an example is 8.60 inches. Now, referring to Table 5a, may be read off (horizontally opposite the figure 8.6 in the first column) all the optimal girth and diameter measurements, skeletal and fleshy, to apply to that measure in corrected ankle girth. The corresponding body weight, in pounds per inch of stature, is given in the final column as 2.320; thus the subject in question should weigh 2.320 x 69.0, or 160 pounds.

When the corrected ankle girth measure obtained is of an amount *between* the .05-inch gradations listed in Tables 5a or 5b, the listed size in corrected ankle girth *nearest* to that obtained should be used to indicate the optimal girth and diameter measurements, while the body weight should be taken as the amount *proportionately* between the next lower and the next higher amounts in the final column.

IN Table 6 is shown the application of the present anthropometric method to the individual extremes of build presented among the subjects comprising the study. By "extremes of build" is meant the subjects possessing respectively the thinnest and thickest skeletal structures in relation to stature. Attention is directed to the conclusion, for comparison, of the "average weight for height and age," commonly taken as a standard for the individual to emulate. The figures for this purpose are taken from the Report of the Medico-Actuarial Investigation, 1912, upon which most of the familiar "height-weight standards" for adults are based. Allowance is made for the height in shoes and the weight clothed.

The comparisons drawn in Table 6 make so manifest the conformity between predicted and observed measurements when the thickness of the skeleton is taken into account, and so equally manifest the lack of conformity between those measurements (as summarized in body weight) when the thickness of the skeleton is ignored, that further comment here on these anthropometric relationships would be repetitious.

To facilitate the obtaining of uniform results from the system of anthropometric diagnosis here introduced, it is essential that

the measurements involved be taken in the manner about to be described. Particularly should great care be exercised in securing accurate values for the skeletal measurements from which the corrected ankle girth is derived. For all the girth measurements a steel tape (or an accurate cloth anthropometric tape) should be used, and in the taking of the measurements of diameter (with calipers of the type used in obstetrics) the distance between the points of the calipers should be *measured*—not read off the radially-graduated dial near the fulcrum; that is, unless the direct reading of the calipers is known to be accurate, for a small error in the measurement recorded on the dial would be proportionately magnified in the distance between the points of the calipers. In the taking of measurements of the fleshy parts, the tape or calipers should be "just" in contact with the skin; any pressure sufficient to compress the tissues being avoided.

In adhering to this principle of measuring, we must disapprove of the tension-regulating spring device on measuring tapes (introduced to eliminate the personal equation of different examiners) since when, with the use of this device, the tape is drawn sufficiently

TABLE 6

COMPARISON OF INDIVIDUAL EXTREMES OF BUILD PRESENTED AMONG 52 MALE SUBJECTS AND 20 FEMALE SUBJECTS, WITH MEASUREMENTS PRESCRIBED ON BASIS OF CORRECTED ANKLE GIRTH AND STATURE

Measurement		Male				Female			
		No. 39		No. 45		No. 6		No. 17	
		Actual	Prescribed	Actual	Prescribed	Actual	Prescribed	Actual	Prescribed
Stature		63.5	"	73.5	"	64.1	"	63.0	"
Weight		180*	176	192	187	115.5	112	132	129
"Average" weight for height and age			130		182		136		116
Skeletal Measurements	Bi-acromial diameter	16.8	17.1	16.1	16.5	—	13.2	14.6	14.3
	Bi-iliac diameter	11.7	11.9	11.4	11.4	—	10.4	10.6	11.3
	Bi-trochanteric diameter	12.4	13.8	13.9	13.2	—	11.8	12.5	12.7
	Wrist girth	7.9	7.55	7.25	7.25	5.75	5.75	6.4	6.25
	Knee girth	16.0	15.7	15.3	15.1	13.5	13.2	13.85	14.3
	Ankle girth	9.8	↓	8.8	↓	7.6	↓	8.95	↓
	"Corrected" Ankle girth		9.38		9.01		7.78†		8.43
Fleshy Measurements — Girths	Neck	17.5	16.9	16.5	16.2	12.6	12.0	13.0	13.0
	Flexed Upper Arm	15.9	15.8	15.75	15.1	10.55	10.6	12.3	11.5
	Forearm	13.25	13.2	13.0	12.65	8.5	9.1	10.35	9.85
	Chest (normal)	43.5	44.0	43.0	42.3	33.0	31.6	36.6	34.3
	Waist	33.3	33.0	32.0	31.7	26.2	24.7	28.6	26.8
	Hips	40.3	40.0	38.8	38.4	36.3	35.3	38.1	38.2
	Thigh	23.5	23.8	23.9	22.9	19.55	20.7	21.65	22.5
	Calf	16.7	15.9	14.7	15.25	12.45	12.8	13.95	13.9
	Bi-deltoid diameter	20.8	20.6	19.6	19.8	—	15.5	17.6	16.7

* Estimated; actual body weight not recorded.
† Derived from the three skeletal dimensions recorded.

taut to compress the spring, the compression of the tissues (increasing in proportion to the softness of the tissues presented) occasioned thereby serves to misrepresent the true peripheral (girth) dimension of the fleshy part measured.

Concerning the Fleshy Measurements:

The girth of neck should be taken at the smallest part; the bi-deltoid diameter at the most lateral protrusions of the shoulders while the arms and chest are maintained in natural carriage; the girth of chest—in a passive state—at the largest part, immediately under the arm-pits and over the scapulae and nipples (in women, above the breasts); the girth of waist at the smallest part; the girth of hips at the largest part, feet together; the girth of flexed upper arm at the largest part, muscles firmly contracted; the girth of fore-arm (arm straight, fist clenched) at the largest part; the girth of thigh (relaxed) at the largest part, generally at the level of the gluteal fold; the girth of calf at the largest part. All girth measurements should be taken with the tape at right angles to the long axis of the limb or part of the body involved; any slanting of the tape is to be avoided. It is now advisable to deal with the skeletal measurements in detail.

Concerning the Skeletal Measurements:

The bi-acromial diameter is secured (facing the back of the subject) by pressing the extremities of the calipers firmly against the most lateral projections of the acromion processes, which should first be located by palpating with the tips of the index fingers. The bi-iliac diameter is taken from in front, the crests of the ilia first being located by palpation and the points of the calipers then pressed firmly against the most lateral extensions of the crests. The bi-trochanteric diameter is next obtained (from in front). First, the greater trochanters are palpated and located as where nearest the surface, then measured across the most lateral projections; the points of the calipers being applied as closely to the bones as possible. In the taking of the bi-trochanteric diameter, as before advised, the feet of the subject should be close together and pointing to the front.

The girth of wrist is measured between the styloid process and the hand, with the hand open, the fingers extended, and the hand in line with the forearm. The girth of knee is taken over the central level of the patella; thigh muscles relaxed, but knees straight and with the weight distributed equally to both legs. The girth of ankle is taken at the smallest part, about two inches above the malleoli; in securing this measurement, it is essential that the subject distribute his weight equally over both feet, as any removal of tension from the Achilles' tendon—especially a lifting of a foot from the floor—results in a diminution of the ankle girth measurement.

(There is another, strictly speaking, skeletal measurement often included in conventional anthropometric tables. That is the horizontal girth of the head. We have, however, found no evidence which would correlate directly the size of the skull with the size of the motor parts of the skeletal structure. For this reason we would not feel justified in prescribing the girth of head on the basis of the corrected ankle girth. However, there are indications that there is at least an indirect relation between the two. For since it appears that the girth of neck is, at all stages of growth, largely determined by the size (volume) of the superimposed skull, the skull could conversely be assigned a volumetric measure (or by extension, a girth measure) in relation to the girth of neck, which in turn is determinable on the basis of the corrected ankle girth measure.)

REGARDING the measurements of fleshy girth, a negative attitude toward the measurement of chest girth seems to exist among most medical examiners, perhaps for the reason that the use of this measurement, with stature, as a *basis for the prediction* of proper body weight has been shown to be fallacious. If all chests presented the proper state of muscular development, chest girth—representing, as it does, one of the largest horizontal cross-sectional areas of the body—would constitute a fairly suitable basis from which to prescribe the fleshy bulk or weight of the entire body. But, since some chests are overly-large because of adipose covering, and others are entirely too small because of a constricted condition of the thorax with a concomitant insufficiency of superlying musculature, the body weight prescribed on the basis of chest girth would in the first condition be correspondingly excessive, and in the second condition, correspondingly insufficient. Fleshy girth measurements must inevitably prove to be inapplicable criteria of proper body weight, for the reason that fleshy measurements, in themselves, give absolutely no information as to the *condition* of the parts of which they express merely the *size*.

However, fleshy girth measurements, of which the chest girth is one, are quite indispensable as *prescribed*—rather than *observed*—bodily characteristics. In other words, while chest girth (or any other fleshy girth) and body weight can be prescribed on the basis of measures of skeletal thickness in conjunction with stature, the reverse does not hold true: body weight, to say nothing of skeletal thickness, can *not* (as a *rule*) be prescribed on the basis of chest girth. For the measurements upon which a formula for ideal physical proportions is to be based should be drawn from parts of the body structure relatively unchangeable in size and presumably sound in condition, so that the *prescribed* characteristics would not be invalidated as a result of being based on *abnormal observed* characteristics.

Further, when *several* prescribed fleshy girth measurements of adjacent parts of the body are compared with the corresponding observed measurements, the uselessness as a gauge of somatic *condition* chargeable to a *single* fleshy girth measurement is largely overcome. For when several prescribed measurements are tabulated opposite the respective observed measurements, any discrepancy between the actual and the optimal *proportions* of the body is at once made apparent; and in most instances the nature of the discrepancy will indicate whether the subject is in good physical condition, insufficiently fleshy, or corpulent.

For example, concerning the most important proportions—those of the trunk: if, of two adult male subjects, one presents a girth of waist measurement 25% smaller than his girth of chest and 15% smaller than his girth of hips, and the other, a girth of waist only 10% smaller than his girth of chest and practically as large as his girth of hips, it can almost be taken for granted that the first subject is in good general condition, while it is plain to be seen that the second subject is corpulent—notwithstanding that the girth of chest measurement in *each* of the subjects might be the optimal size prescribed.

Therefore, to insure that the prescribed weight of the body be assigned proportionate *distribution* to the various parts, it is advisable that at least the three major fleshy girth measurements of chest, waist, and hips be taken on each person examined, so that the observed *proportions* of the person as shown by these measurements may be compared with the corresponding measurements prescribed as optimal. And, if time permits, a recording of the measurements of the limbs also will, by affording additional comparisons, enable a still more complete anthropometric diagnosis to be made.

THROUGH an arranging, in each of the male and female subjects, of the actual ankle girth dimension and the five implied ankle girth dimensions according to the numerical degree to which each dimension conforms with the measure of "corrected ankle girth," we have been able to arrive at a fair idea of the respective value or adequacy of each of the skeletal measurements as an index of general thickness of frame.

In the muscularly-developed male, the best single criterion of skeletal thickness is the girth of knee; next, almost equal in respective values, are the girth of ankle and girth of wrist. Then follows the bi-iliac diameter, the bi-trochanteric diameter, and lastly the bi-acromial diameter.

In the female, the distinctly best criterion is the girth of wrist; followed, to a considerably lesser degree, by the bi-trochanteric diameter. Next, the girth of knee and the bi-acromial diameter appear

as of practically identical value; then, in order, the girth of ankle and the bi-iliac diameter. From the foregoing, it appears that the skeletal girths, particularly in the male, are to be regarded as better criteria of general thickness of frame than are the skeletal diameters.

The relative value in each sex of the six skeletal measurements, as just given, may correspondingly be interpreted as the degree to which each respective measurement regulates or determines the magnitude in girth of the fleshy parts of the body. Thus, if one were compelled to derive the corrected ankle girth measure from a single skeletal dimension, it would be best to take the girth of knee in the male or the girth of wrist in the female.

In the male, the best conformity in proportion between any two skeletal dimensions is in the case of the bi-acromial diameter and the bi-iliac diameter, in which a practically identical relative proportion in size is presented in 30% of the subjects. A similar proportionate relation in size between girth of knee and girth of ankle is shown in about 20% of the subjects, and between bi-trochanteric diameter and ankle girth in about 15% of the subjects. Otherwise, no definite relationships are apparent.

In the female, the conformity in proportion is present between the bi-acromial diameter and the bi-iliac diameter in 40% of the cases, and between the bi-trochanteric diameter and the girth of knee in an equal percentage of the subjects.

WE HAVE already mentioned the possibility of having to derive the corrected ankle girth from a single skeletal dimension. This necessity should rarely present itself. But there are instances, as in pronounced obesity, where the thick padding of fat presented precludes the attaining of accuracy in many of the skeletal measurements. In such instances the corrected ankle girth can only be derived, as best as may, from a measuring of the bony parts least obscured by fleshiness. In all cases where the corrected ankle girth is derived from fewer than six skeletal dimensions, the method of obtaining a weighted average value, as previously described, will, of course, have to be modified in accordance with the number of measurements utilized.

In the majority of cases of moderate obesity, it will be found that the wrist girth and the bi-acromial diameter present very nearly their normal dimensions irrespective of the degree of fatty accumulation elsewhere on the body, and are therefore in such cases the best criteria of skeletal thickness. With practice, however, the user of this method should in all but a few exceptional cases (which obviously imply a greatly over-weight condition) have little difficulty in deducing without significant error the general thickness of the frame as expressed by the corrected ankle girth. With subjects of the

other extreme—so "skinny" that the bones almost appear on the surface—the applicability of the system is surprisingly reliable.

Perhaps at some future date a method may be devised whereby a life-size but inexpensive X-ray picture of the subject's skeleton can be used as a basis for the prescription of the fleshy measurements. In such event, no matter how corpulent the subject, his true size of frame would be revealed!

Finally, there is the possibility to consider in which the skeleton itself presents dimensions the result of some pathologic condition. If the bones are atrophied from disuse or from glandular disfunction, abnormally thickened as a result of metabolic hyperfunction (as occurs in the endocrine disorder of acromegaly), or for any other reason of a size definitely unattributable to normal heredity and environment, the method here presented is, manifestly, of lessened value for the purpose for which it is designed.

By "adult"—to which the present formulae are restricted—is meant the mature configuration of physique, regardless of chronological age.

THE following blank, "Anthropometric Record and Diagnosis," (filled-in for illustration purposes with the actual measurements of an unselected subject) is submitted as a suitable form for the recording of the actual and the optimal measurements of each subject examined. It shows clearly how, when once the measure of corrected ankle girth has been arrived at, comparisons can be made between the prescribed optimal measurements (taken from Table 5a or 5b) and as many of the corresponding actual measurements as have been recorded.

It takes only from five to ten minutes to secure the essential measurements of stature, weight, the six measures of skeletal thickness (including right and left sides in the girth measures) and the three major fleshy girth measures of chest, waist and hips; then another five minutes or so for the minor fleshy measures of bi-deltoid diameter and the respective girths of upper arms, forearms, neck, thighs, and calves. Is not the time taken to secure these measurements well spent if thereby a definite and reliable supplementary diagnosis of the individual subject's physical status is afforded?

ILLUSTRATION 1 shows in conventional representation the external aspect of the optimal figure in front, side, and back views, and the location and comparative size of the measurements of skeletal thickness adopted. As stated in connection therewith, the transverse and antero-posterior dimensions indicated apply *only* (as they necessarily must, in a single illustration) to a thickness of skeleton *medium* in relation to stature. The same *proportions* of the figure (i.e., size-relationship of horizontal girth and diameter meas-

ANTHROPOMETRIC RECORD and DIAGNOSIS

No. 76 Date. Jan. 18, 1932.

Name. Jones, Albert N. Sex. Male Age 32 yrs. 5 mos. Nationality English-Irish

MEASUREMENTS

	Actual (observed)		Optimal (prescribed)
	67.0	Stature	(same)
	163	Weight	166
Skeletal Measurements	15.4	Bi-acromial diameter.	16.3
	11.6	Chest diameter, trans.	12.1
	8.0	Chest diameter, ant.-post.	8.4
	11.2	Bi-iliac diameter.	11.3
	13.2	Bi-trochanteric diam.	13.1
	7.0	Wrist girth, R.	7.2
	7.0	Wrist girth, L.	7.2
	15.4	Knee girth, R.	14.9
	15.2	Knee girth, L.	14.9
	9.1	Ankle girth, R.	"Corrected" Ankle girth
	9.3	Ankle girth, L.	8.90

	Actual (observed)		Optimal (prescribed)
	18.5	Bi-deltoid diameter.	19.6
	15.6	Neck	16.0
Fleshy Measurements	12.9	Upper arm, flexed, R.	15.0
	12.6	Upper arm, flexed, L.	15.0
	11.6	Forearm, R.	12.5
	11.3	Forearm, L.	12.5
Girths	40.2	Chest, normal	41.8
	33.9	Waist	31.3
	38.9	Hips	37.9
	22.0	Thigh, R.	22.6
	22.0	Thigh, L.	22.6
	15.0	Calf, R.	15.1
	15.5	Calf, L.	15.1

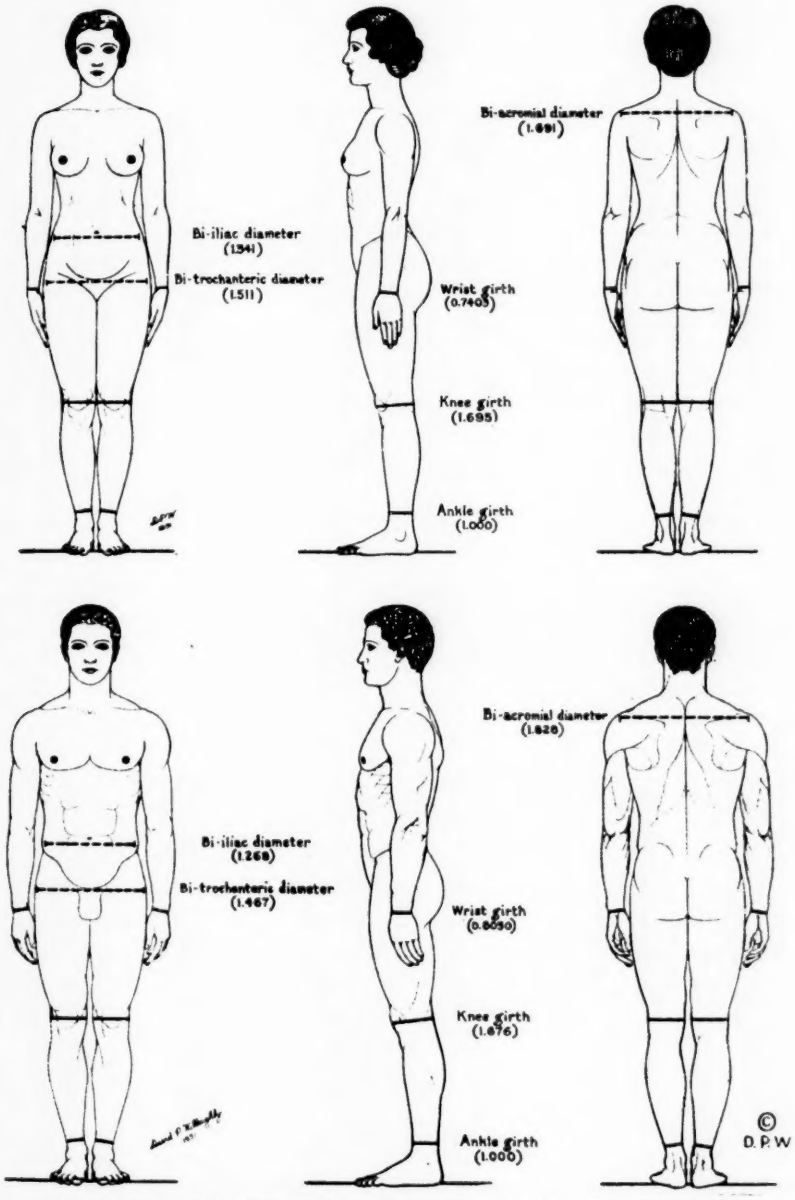
Remarks. Corrective measures indicated: Principally a redistribution of present body weight; muscular exercise for the reduction of the waist and hips and for the development of the chest and arms

R. O. Smith, M.D., Examiner.

Illustration 1

OPTIMAL PROPORTIONS OF THE HUMAN FIGURE

(Illustrated on figures having a skeleton of MEDIUM thickness in relation to stature)



Heavy dotted lines indicate diameter measurements, and heavy full lines, girth measurements, adopted as criteria of skeletal thickness.

Numbers in brackets express the optimal size-relationship of these skeletal measurements (in the adult) when the girth of ankle is taken as 1.000.

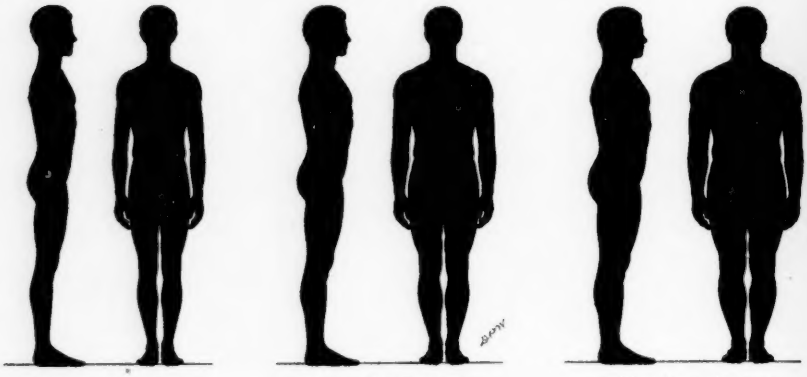
These ratios of size-relationship (of thickness) hold true irrespective of whether the individual is extremely slender, extremely thick-set, or of any intermediate conformation of figure.

Illustration 2

OPTIMAL PROPORTIONS OF THE HUMAN FIGURE

IN APPLICATION TO DIFFERENT DEGREES OF SKELETAL THICKNESS

- Male Adult -



Skeleton 15 per cent. Thinner than Medium

Skeleton of Medium Thickness in relation to Stature

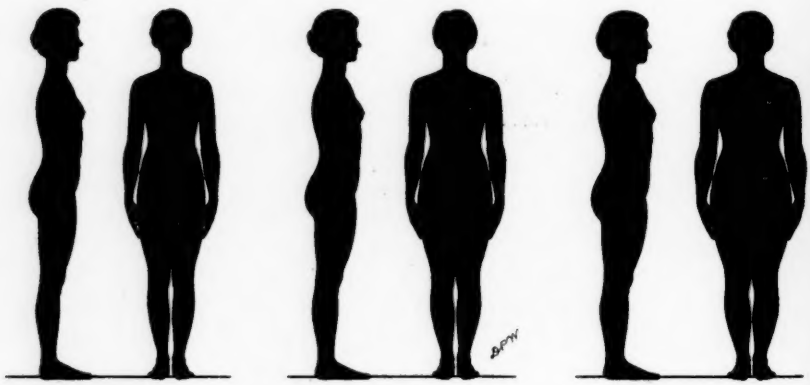
Skeleton 15 per cent. Thicker than Medium

Illustration 3

OPTIMAL PROPORTIONS OF THE HUMAN FIGURE

IN APPLICATION TO DIFFERENT DEGREES OF SKELETAL THICKNESS

- Female Adult -



Skeleton 10 per cent. Thinner than Medium

Skeleton of Medium Thickness in relation to Stature

Skeleton 10 per cent. Thicker than Medium

ures) prevail in application to *all other degrees of skeletal thickness* in relation to stature, from the extreme of slenderness to the extreme of thick-setness. Two arbitrarily chosen degrees of skeletal thickness (with musculation in correspondence) in addition to the medium are depicted in silhouette form in Illustrations 2 and 3. These chosen degrees of body build are sufficiently approximative to the respective "light" and "heavy" limits to afford imaginary pictures of the infinite intervening degrees.

We would like at this point to apologize for the posture depicted in the two side views in Illustration 1; the male figure in particular being faultily-posed in that the lower extremity is not perpendicular to the base-line. These inadvertent postural defects in the side views we have endeavored to remedy in Illustrations 2 and 3, while maintaining the same size-relationships throughout. These two-dimensional presentations of girth measurements (principally) were made possible through the establishment of the optimal *cross-sectional contour* of each of the anatomical parts at the level where measured.

SUMMARY

1. The relative *proportions* of the human figure are of far greater physiological significance than is the mere measure of its total bulk; weight, therefore, should be considered secondarily to the inter-relationship in size of the various linear (girth and diameter) measurements of the body.

2. The girth measurements of the fleshy parts of the body and limbs should be prescribed on the basis of the general *thickness* of the skeleton.

3. In arriving at a dimensional unit to express satisfactorily the general thickness of the skeleton, measurements indicating the girth of the *bones of the extremities* must be used in addition to the skeletal diameter measurements of the trunk.

4. An original method is here introduced which prescribes for any adult person the *optimal*—not the average—horizontal girth and diameter measurements, skeletal and fleshy, of *all* parts of the body. The basis for these prescribed measurements is an *index* measure of the general thickness of the skeleton as derived from six observed skeletal measurements of the trunk and extremities.

5. The method here presented is correctly applicable to *all* adult persons (of the white race), irrespective of nationality or of so-called "type" of body build.

6. This treatise dealing with the adult man and woman serves to introduce certain principles of anthropometric procedure which will be incorporated at a later date in similar formulae and tabulations for the optimal physical proportions of *children* during all stages of development.

Distances Traversed By Football Players

By Lloyd L. Messersmith and Paul Fay
DePauw University

In a series of experiments performed by the writers an effort was made to discover some facts pertinent to the distances traversed by football players during a game of football. The material recorded here is a continuation of the work reported at an earlier date in connection with distances traversed by basket ball players.*

The apparatus used in obtaining the results given here consisted of a football field laid off to scale on a tin base. The gridiron was reproduced on the tin base to the scale of one-eighth inch to the foot, which provided for a miniature football field 45 inches long and 20 inches wide, equipped with yard lines, goal lines and all distinctive marks of a regular football field which would aid the operator in duplicating upon the miniature field the movements of the player on the gridiron. This base was wired in series with two 4½-volt dry cell batteries, an electric impulse counter, and a small tracing wheel four inches in circumference. The wheel was insulated at half-inch intervals so that a make and break was made in the electric circuit, every half inch, as the wheel was rolled over the surface of the tin field. With the scale of one-eighth inch to the foot, each make and break of the circuit represented a distance of four feet covered by the player traced on the field. The impulse counter was equipped with a measuring device which recorded the result each time it was subjected to an electric impulse. Thus, as the wheel was rolled over the base, the counter recorded a series of clicks resulting from the makes and breaks in the electric circuit produced by the insulated sections of the tracing wheel as it came in contact with the floor. Since each click represented a distance of four feet, it was only necessary to multiply the number of clicks by four to find, at any time, how many feet the individual being traced had traversed.

The apparatus seemed to measure accurately, as rolling the wheel from goal line to goal line produced a total of seventy-five clicks, which multiplied by four gave three hundred, the number of feet from goal line to goal line on a regulation football field. Therefore, any inaccuracy in the results obtained would lie in the inability of the operator to duplicate accurately on the tin field the movements of the player on the football gridiron.

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*Stephen M. Corey and Lloyd L. Messersmith, "The Distance Traversed by a Basketball Player," *Research Quarterly*, (II May, 1931), 57.

The operator of this device made his observations from the press box on the fifty yard line, well above the field and in a position which enabled him to observe clearly the movements of all players at all times. From this position the operator traced players in all positions, in scrimmages, in regular practice sessions, and in regular intercollegiate and interscholastic games. Data was obtained on distances traversed during offensive and defensive periods, during "time in" and "time out" periods, and in the four quarters of play.

The results recorded in this report were obtained from players observed in two college games and one high school game. These three games were selected at random from some eight to ten games which were clocked during the season. The college games were 60 minutes in length, the high school 48. As a matter of convenience we will refer to these games as games No. 1, 2 and 3. In game No. 1 the man playing the right half-back position was observed; in No. 2 the left end; and in No. 3 the high school half-back was traced. In all three games the scores were comparatively close and the teams well matched, there being no more than 12 points difference between the final score of the winner and the loser.

In game No. 1 the half-back traveled 7,320 feet on offense and 8,680 feet on defense, a total of 16,000 feet or 3.03 miles; the distances for games 2 and 3 were 8,920 feet and 6,860 feet respectively for offense and 6,880 and 6,500 feet for defense. In game No. 1 the player observed traveled 9,860 feet during the "time in" periods or when the official watch was running, which totaled 60 minutes in all. However, he traveled 6,140 feet during the "time out" periods, which represented a total period of 65 minutes and 47 seconds. The numbers here represent distances traveled after incompleted passes, out of bound plays, touchdowns, safeties, touchbacks, etc., when the timer's watch is stopped. The player is not working under any great pressure during this period, but the results show that a player is in action considerably more than 60 minutes in a college football game and that he covers on an average from one-fourth to two-thirds as much territory while the game is not in progress, as far as the official's watch is concerned, as he does during the 60 minutes of playing time.

In game No. 2 the left end traveled 11,780 feet during the "time in" periods and 4,020 feet during the "time out" periods. The "time out" periods in this game represented 46 minutes and 57 seconds. During the game there were 59 "time outs," exclusive of the "time outs" taken at the close of the quarters and half, making an average of 68.1 feet traveled by the end for each "time out." The average for the "time in" periods was 199.6 feet.

In the high school game the half-back traveled 10,620 feet during the "time in" periods and 2,740 feet during the "time out"

periods. In game No. 2 the greatest distance for any one "time out" period was 380 feet, while the longest distance for any one "time in" period was 920 feet. During game No. 1 the longest offensive distance was 920 feet and the longest defensive distance was 1,720 feet. The shortest distances for any one period of offensive and defensive periods of the same game were 120 and 240 feet respectively.

The results show that the activity of the players was comparatively regular during the four quarters of play and that the distances traversed were a function of the score and type of game employed rather than the fatigued and physiological state of the players. In game No. 1 the half back traveled 1,560, 6,560, 4,080, and 3,800 feet respectively in the four quarters of play.

Of all the games observed during the year the longest distance recorded was 19,240 feet, or 3.64 miles. The player covering this distance played in the half-back position on a college team. The shortest distance recorded was that traversed by a tackle in a college game. The distance was 10,680 feet or 2.02 miles.

Comments on the "Push-Up and Pull-Up"

By Wm. G. Anderson, *M.D., M.P.E., D.P.H.*
Director Yale Gymnasium

I HAVE read with more than passing interest Mr. C. H. McCloy's article on "A New Method of Chinning and Dipping" which appeared in the December issue of the Research Quarterly of the A.P.E.A. and am led to present data gathered thirty years ago, and to place before those who might possibly be interested certain findings which resulted from my own research along these lines.

Mr. McCloy faces the same difficulties with which the Society of Physical Directors in Colleges was then confronted, namely, the inaccuracy of determining in foot-pounds the actual work done by anyone who makes a record of strength by pulling or pushing up.

Those with limited experience know that one person may lift the body a foot or less while another will elevate his weight eighteen or even thirty inches but this individual will receive credit for only twelve inches in order that the work done may be recorded in foot-pounds. The unfairness of such a method is obvious.

Mr. McCloy's use of the figures is not questioned for he has given time and study to securing his data, but if he bases his findings upon the lifting of the body just one foot then he will know that such observations are inexact.

In my annual report to President Arthur Hadley, I said: "This present scheme which tests the strength of the various groups of muscles in the human body must be modified before it is satisfactory. A change should be made in what is known as the 'Pull up,' or in laity language 'Chinning,' which consists of hanging and raising the body until the chin touches the bar or support."

When performing this test the student may take one of three grasps:

1. Hanging with the palms of the hands front or Ordinary grasp
2. Hanging with the palms back or Reversed grasp
3. Hanging with the palms in or Side grasp

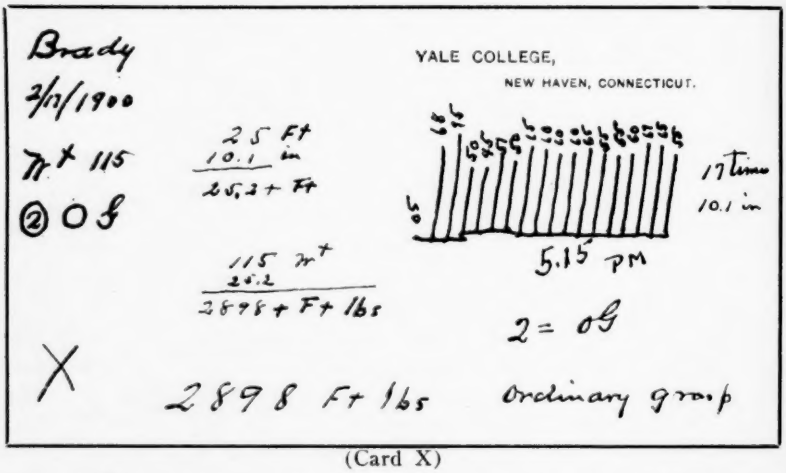
If a student raises his body, which weighs 150 pounds, ten times, an arbitrary result of 1500 foot-pounds is tabulated, which result is used as one criterion of his strength.

These questions have arisen pertinent to this special event:

A. How high does a student lift his body?
B. Which is the best of the three grasps for making a record?

C. What is the actual amount of work done indicated by foot-pounds?

These questions have never been accurately answered because the eye alone has been the judge. In order to settle the debate I devised a machine or ergograph, the same to be used in making a series of tests. The accompanying photographs will give an idea of the instrument.



(Card X)

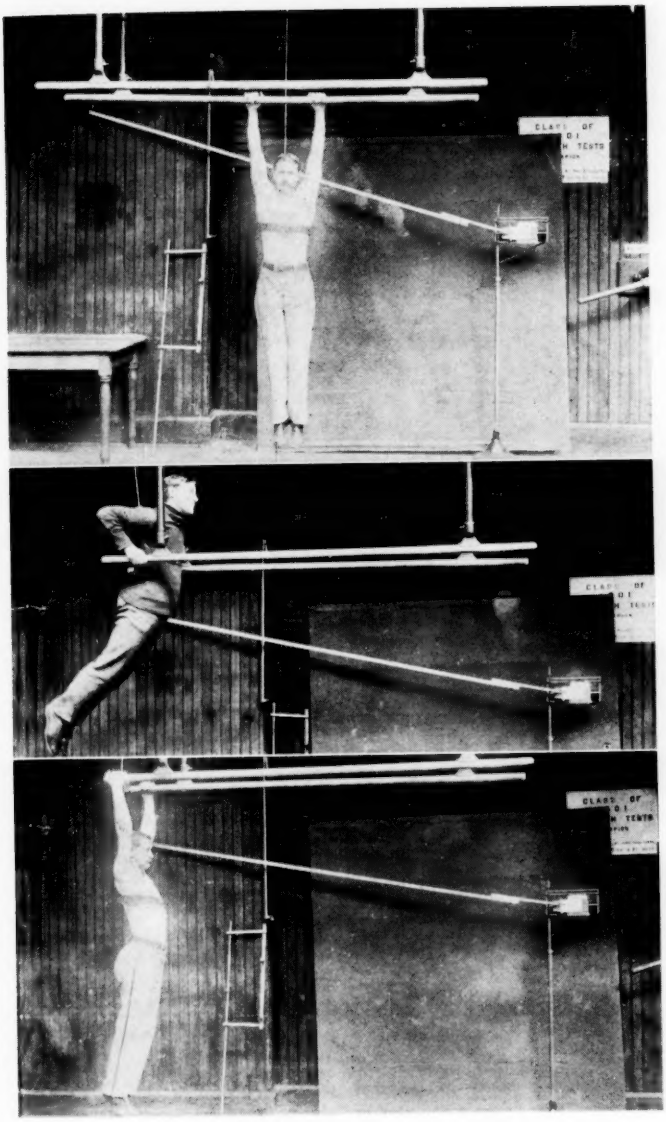
The Student "chinned" 17 times (slight plus) or 10.1 inches. Two and one-half feet for each calibrated inch gives 25.2 actual lift. Weight 115 multiplied by 25.2 feet gives 2898 foot-pounds total. Each line of the staircase was measured in 1/100 of an inch, equals 10.1 inches. The figure "2" means second test for that date. O. G. means ordinary grasp. By the old method his weight would have been multiplied by 17—result 1955 foot-pounds. This subtracted from his actual work shows a discrepancy of 943 foot-pounds (loss). The name, weight, hour, date, grasp were recorded with pencil but inked over to make the reproduction clearer.

Mr. B's record was chinning 33 times. Height 63 feet. Total in foot-pounds 7308, reversed grasp. Weight 116 lbs. Date 2/28/00. Time 5:30 P.M. Loss in weight one-half pound. Difference between collegiate method and ergographic showing is 3480 foot-pounds (loss).

A belt is attached to the body of the student to which is fixed a cord which runs over lubricated pulleys and is fastened to a ten-foot lever. At the end of this lever is a flexible stylus which traces lines upon a card. The lift of the body is recorded by the operator who releases the carriage just before the "lift."

The card calibration is one inch for each two-and-a-half-foot "chin." As smoked drums are not required the records can be very rapidly registered, while the simplicity of the ergometer has made investigations easy.

The enclosed card shows a fatigue staircase. The sum total of the length of the lines multiplied by two-and-one-half gives the exact



DR. ANDERSON'S ERGOMETER

distance the body has been lifted. This multiplied by the body weight gives a result in foot-pounds which is sufficiently accurate.

The ergographic studies were made during January, February, and March of 1900. Members of the elective course and the freshman class assisted willingly.

Without going into too many details which might not be of interest, I present a few conclusions. These are based on a study of the data gathered from observations made with twelve men:

A. Average amount of work done with—

Reversed grasp	2845 foot-pounds
Ordinary grasp	2259 foot-pounds
Side grasp	2832 foot-pounds

B. The greatest gain by practice was in the—

Side grasp	393 foot-pounds
Ordinary grasp	305 foot-pounds
Reversed grasp	199 foot-pounds

C. The highest records were made with the reversed grasp but it does not follow that this would be the "superior hold" if the students were given time to practice the other grasps.

D. The highest individual record was 7308 foot-pounds.

E. The average height to which the body was raised was one and seven-tenths calibrated inches.

When the body was lifted ten times, the sum total of the tracings indicated 17 inches which multiplied by 2.5 feet for every stylus inch gives 42.5 feet the distance the subject actually raised his body. Next multiply the body weight of 150 lbs. by this distance and we have 6375 foot-pounds. Comparing this method with the scheme adopted by the Society of College Gymnasium Directors we find that the student was credited with only a one-foot lift every time he "chinned" himself regardless of the exact distance, and multiplying his weight of 150 lbs. by ten he receives credit for only 1500 foot-pounds regardless of the additional feet and inches. Subtract the collegiate record from the actual finding and we have a discrepancy of 4875 foot-pounds. Deductions based upon such inaccuracies cannot be scientific. A study of E shows the Intercollegiate marking unfair to the student as he receives credit for one foot only.

F. A number of men habitually lifted their bodies more than two feet.

We have endeavored to make the above tests accurate and while we do not believe they are in themselves of great value, yet they are suggestive and when combined with other investigations which will be made later with the ergograph, they will, no doubt, be helpful to the Gymnasium Director.

On page 137, Mr. McCloy uses the expression "Pulled all the way up" (italics). What does this mean?

A person may start the pull with the arms slightly bent and lift the body to the top of the head, to the chin, to the clavicles, or to the nipples. Here are differences in inches which should be recorded but evidently are not.

On page 139 in the footnote, Mr. McCloy says "That chinning and dipping are quite useless as a classifying device unless the individual chins and dips to the limit."

The limit among college men is the nipples which gives us about 30 inches as a working basis, but school boys do not often approximate this. (I refer to chinning and not dipping.)

The average number of times the Yale freshmen chinned themselves was nine. The dip was six. Twenty is good and thirty the exception. Charles Chadwick, the intercollegiate strong man, chinned himself between sixty and seventy times and dipped over seventy times. Dr. Seely of Amherst held the "chinning" record for years. The figure was over sixty. The writer, with a gymnast's build, often went over forty with both hands and three times with either hand but the body was lowered full length.

Every teacher knows the difference between lowering the body to its limit or partly down. This is especially true of the single arm draw-up.

When a subject tried the "pull up" on the rings the grasp was half way between the reversed and the side grasp which leads me to surmise that the adjustment of the muscles determined the best grip. This was taken unconsciously as the rings were not fixed. "Kicking and a body swing" were not permitted.

A study of the staircases will throw additional light on the methods and results.

In conclusion—I hold no brief against Mr. McCloy's use of his data but only against the inexactness of the length of the pull-up.

A Motor Ability Test for University Women for the Classification of Entering Students Into Homogeneous Groups

By Florence D. Alden
University of Oregon

Margery O'Neal Horton
Bellingham Normal School

Grace Marie Caldwell
Detroit Public Schools

ACKNOWLEDGMENT

The authors take pleasure in acknowledging their indebtedness to those who have given their generous assistance. We desire to express our sincere thanks to the students at the University of Oregon for their co-operation in the testing program. We are especially grateful to the members of the faculty of the School of Physical Education for their generous assistance in securing test data, to Mr. Ralph E. Leighton for his invaluable work in checking data and his advice in procedures, and to Dr. John Bovard for his inspiration, suggestions and constant help and guidance.

CONTENTS

INDEX TO TABLES

INTRODUCTION

TERMINOLOGY in the comparatively new field of physical education is not sharply defined. Many terms are used by different writers to signify the same quality. Such terms as physical ability, physical capacity, physical achievement, motor ability, athletic ability, native motor ability and many others, have all been used to indicate the measurement of the skill of the body. Obviously, some of these are applicable to the present problem and some are not.

The term physical or motor capacity connotes potential as well as actual, and native rather than acquired ability, hence, could not be applied to the present study. Also an individual may have the *capacity* to do a thing and not the *skill* to do it.

Since this study is concerned only with the present ability of the student, there is no attempt made to isolate native ability; however, there are some who believe that native motor ability can be measured. Inasmuch as the child from birth is subjected to the training of others, it seems difficult to imagine that native motor ability, or the motor ability with which the child is born, could be isolated from the effect of education and measured at the age of twenty, forty, or sixty. We are accustomed to think of native ability as a constant thing; thus, if we gave a test to measure native motor ability and found that the individual could not pass the test, then we would concede that he was lacking in that particular native ability. If, however, we gave the test a second time and it was passed, then we must conclude that at least part of the ability was acquired.

Ability usually connotes such qualities as arise from training and indicates actual skill rather than the potential alone. The term motor ability seemed to be significant in this case since this experiment is an effort to measure the present aptitude for physical skills.

Testing in physical education has received a distinct impetus in the last few years. The results of the work of the committee appointed by the College Women Directors of Physical Education in the spring of 1923 may be found in the report of Agnes Wayman.[1] This test was designed to measure the power of the individual to produce, and consisted of a Medical Test, an Anthropometric Test and a Motor Ability Test. The scoring system placed a premium on physical fitness by making it possible to score twice as many points in the medical test as in the motor test.

The result of the work of Garfield[2] on the Measurement of Motor Ability may be found in the *Archives of Psychology*. The aspects of motor ability as catalogued are: speed of voluntary move-

[1] Agnes R. Wayman, "A Scheme for Testing and Scoring the Physical Efficiency of College Girls." *The American Physical Education Review*, (November, 1923).
[2] Evelyn J. Garfield, "Measurements of Motor Ability." *Archives of Psychology*, Volume 9, No. 62.

ment, accuracy of voluntary movement, control of involuntary movement, strength, and motor adaptability. The tests are of both the small and large physical skills and involve such events as the three hole test, the hand steadiness test, puzzles, moving of fingers, running, and different tricks. Garfield's main experiment was to obtain a series of tests that should adequately measure motor ability. The final battery of tests is as follows: running (100 yard dash); picking up paper; strength of back (by dynamometer); tricks; steadiness; tapping; leg strength (by dynamometer); hand strength (by dynamometer).

Brace[3] has also worked out, by means of scientific procedures, a group of events which are intended to measure native motor ability rather than that acquired. The tests are of the nature of stunts which are easy to administer and are scored simply as "success" or "failure." The data obtained by Brace involves thousands of cases from adults to children. The least homogeneous group on which the tests were tried was that of college women. In this group, the coefficients of correlation were the lowest of any group, indicating that possibly the tests were less suitable for college women than for other groups.

By adequate statistical proof, Rogers[4] has established the validity of a series of physical capacity tests as measures of general athletic ability in boys and has secured high correlations between the tests he proposes (a strength index) and athletic ability tests such as running, jumping, and throwing. Rogers measured the physical capacity by: forced lung capacity, strength of grip, strength of back, strength of legs, and strength of arms; and the athletic ability by: two sets of tests, the first set including the 100-yard dash, running high jump, running broad jump, and standing bar vault; the second set including the two lap run, standing broad jump, shot put, basketball goal and baseball throw. The different physical skills measured by these events are running, throwing, jumping, and vaulting as shown by the judgments given by Cozens[5] and those few test events would probably adequately measure athletic ability if they had a high correlation with a composite score on many events.

During the years 1924, 1925, and 1926, the University of Oregon Department of Physical Education for Women gave physical efficiency tests designed to measure the physical ability of entering freshmen women. If the tests were passed with a certain score the women were permitted to elect their physical activity. If the tests were not passed the women were placed in restricted work. These efficiency tests were set up in 1924 and have now been abandoned

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3 D. K. Brace, *Measuring Motor Ability*, (1927), pp. 105-124.

4 F. R. Rogers, *Physical Capacity Tests in the Administration of Physical Education*, (1927). Chapters 3, 4, 5.

5 Frederick W. Cozens, *The Measurement of General Athletic Ability in College Men*. Chapter I.

because a statistical study covering three years showed that a re-test after a short interval will reduce the range and lower the average and that a third test after a term of activity gives a lower average and a more reduced range than in the second test, indicating that the self correlation after a short period of time would be very low.[6] Also it was not known just what phases of all-round physical ability were measured.

In 1928 Cozens[7] completed a study of the *Measurement of General Athletic Ability in College Men,* the general plan of which has been followed in our attempt to measure the general motor ability of college women. In many instances the results have been strikingly similar, indicating that the measurement of general motor ability in college women requires a procedure not unlike that for the measurement of general athletic ability in college men, though the tests themselves are not the same in most instances.

The scientific movement in educational measurements has made it necessary for college administrators to make some classification to separate the various degrees of physical ability as well as the various degrees of mental ability. If this is not done, we find students with high degrees of basic motor skill in the same teaching units with students markedly low in coordination. Also it is important to conceive that the measurement of ability is the fundamental basis for the measurement of accomplishment.

A wide divergence of standards in physical education throughout the elementary schools makes it impossible for college students to fall naturally into a homogeneous grouping whereby all in the group are nearly equal in physical ability. Some have received twelve years' work in physical education while others less fortunate have had almost no physical education. To place these students at random in groups or sections without testing would be comparable to placing first year and fifth year French students in the same class.

Experimental testing in physical education has been a definite indication of the need felt by educators for some highly reliable test which can be used to classify college women according to their motor ability.

With this need in mind the following study was undertaken.

CHAPTER I

Classification of College Women

THE purpose of this study is to set up a battery of tests which can be used to classify freshman college women according to their motor ability. In the selection of the tests the following points were taken into consideration.

[6] Ruth Dunlap, "An Agility Test for Women Students." A statistical study covering three years at the University of Oregon.

[7] Cozens, *loc. cit.*

1. The tests should be simple to administer so that assistants can follow easily understandable directions.
2. The tests must be easy to score in objective units so that no personal judgment is involved.
3. The tests must be valid, that is, they must measure what they purport to measure.
4. The battery must be one which can be given in a short time and one which does not involve complicated set-ups or apparatus.

Composition of General Motor Ability

In order to obtain a composite idea of what constitutes general motor ability, judgments were secured from twenty representative physical educators on the Pacific Coast and throughout the United States. Using these judgments of fundamental bodily skills which are necessary for success in any and all branches of motor activity as a basis, the study proceeded along well defined lines. The letter and form for reply are shown below:

Dear Miss ————:

Almost all of us seem to be struggling with the problem of methods of classifying our students. Pretty nearly every time we get together either informally or in conference this subject comes up for discussion. We are making an effort this year to form a small, easily administered battery of tests that can be applied to the entering girls to classify them somewhat roughly on the basis of their motor skills.

One of my majors, Margery Horton, is writing her Master's thesis on this, and anything that she evolves we will run through the department classes. We are starting out with an effort to get, from people that we know are interested, judgments on the following points:

1. The fundamental bodily skills which are necessary for success in any and all branches of physical activity.
2. An objective test for each skill named, that is, a test which can be accurately timed and measured in some way and which is feasible for a university department of physical education to give. For this judgment I am enclosing a special sheet.

I know you are enormously busy and that you get a steady stream of questionnaires, etc., for I do myself. I hesitate, therefore, to send this to you, but as we are all working on these same things, perhaps working together will help us.

Do let me know if you are doing anything interesting along these lines and I should be glad to give you the results of our work if you care to have them.

Very sincerely yours,

SAMPLE OF ANALYSIS SHEET

.....

(Name of person expressing opinion)

.....

(Official position in full)

Number of years' experience teaching physical education:

Fundamental Bodily Skills (as per example)	*Objective Tests*
1. Speed in running	1. 100-yard dash for time
2.	2. .....
3.	3. .....
4.	4. .....
5.	5. .....
6.	6. .....
7.	7. .....
8.	8. .....
9.	9. .....
10.	10. .....
11.	11. .....
12.	12. .....
13.	13. .....
14.	14. .....
15.	15. .....
16.	16. .....
17.	17. .....
18.	18. .....
19.	19. .....
20.	20. .....

Table I indicates a summary of what the judges believe to be the fundamental bodily skills which are necessary for success in any and all branches of physical activity.

TABLE I

Summary of Judgments on Fundamental Bodily Skills

Speed:
Including such tests as 100-yard dash, 50-yard dash, distance run in seven seconds, etc.

Strength of Legs:
Including such tests as running high jump, standing broad jump, standing high jump, running broad jump, deep knee bending, etc.

Endurance:
Including such tests as a single strength test repeated in sequence, a run measured in time and distance, etc.

Balance:
Including such tests as walk beam, stand on toe on one foot, measure body oscillations, Brace Tests, etc.

Arm and Shoulder Strength:
Including such tests as chinning, hanging, rope climb, arm bending from front leaning rest, etc.

Arm and Shoulder Coordination:
Including such tests as baseball throw for distance, basketball throw for distance, javelin throw, etc.

Accuracy (hand-eye, foot-eye, arm-eye coordinations):
Including such tests as basketball shooting, baseball window throw, catch ball on return bounce, tennis serve for placement, golf putt, pursuit pendulum test, etc.

Agility, control, coordination:
Including such tests as knee chest vault over low boom, forward roll, standing fence vault, running straddle vault, hurdling, stunts, etc.

Flexibility:
Including such tests as through the stick, kick to level of shoulders, grasp bow standing—arm bending, arm flinging between cross and fly, etc.

Swimming:
Including such tests as distance swim, distance covered by each stroke, treading water, floating, etc.

Abdominal Strength:
Including such tests as lying-trunk raising, hanging-leg raising, dynamometer tests, etc.

Rhythmic Sense:
Including such tests as walk to 4/4 time, repeat a given note pattern, Seashore Test,[8] etc.

This classification is very similar to that obtained by Cozens[9] from the judgments of fifty-two representative physical educators on the Pacific Coast.

From the above replies the final classification was worked out. Those tests were chosen which could be measured objectively and which could be given in a short time. Also those tests which involved simple apparatus were chosen to a large extent. Swimming was eliminated from this testing problem because it requires a different medium than that which we normally have. Also it requires special instruction and testing. Table II shows the final classification as worked out.

TABLE II
Final Classification

FUNDAMENTAL BODILY SKILLS	OBJECTIVE TESTS
1. Speed	50-yard dash
	Change balls
2. Strength of legs	Standing broad jump
	Jump and reach
3. Endurance	Hand dynamometer
4. Balance	Walk balance beam
5. Arm and shoulder strength	Bend high hang
6. Arm and shoulder coordination	Baseball throw for distance
7. Accuracy	Ball roll
	Baseball target throw
8. Agility	Through window ladder
9. Flexibility	Through the stick
10. Abdominal test	Trunk bend
11. Rhythm	Tapping

Note: It is obvious that there is overlapping both in the elements and in the tests. No ability can be broken up into distinctly defined elements nor can tests be found that measure fully each element and only that element. No attempt is made here to do this.

[8] Robert Seashore, "Stanford Motor Skills Test." *Psychological Monograph*, Vol. 39, (1928), pp. 51-66.
[9] F. W. Cozens, *loc. cit.* pp. 129-131.

CHAPTER II

The Oregon Test

THE tests were given the first time to nine freshman and sophomore classes at the University of Oregon during the third term of 1928-29. The total number of women considered is 149, since only this number completed the test. The classes taking the test were: Beginners' classes in tennis, canoeing, archery, dancing, and swimming; advanced class in clogging; freshman majors taking beginning hockey; and the highly specialized senior major class. The test was given to the senior class for purposes of comparison with the freshman and sophomores.

Administrative Procedure

The fourteen tests given were divided into two groups of seven tests each, in such a manner that the element of fatigue was eliminated as nearly as possible. The two groups are as follows:

Group I	Group II
50-yard dash	Through the stick
Bend high hang	Tapping
Baseball throw for distance	Hand dynamometer
Through window ladder	Ball roll
Baseball target throw	Change balls
Jump and reach	Trunk bend
Standing broad jump	Walk balance beam

The first group was given on Monday and repeated on Wednesday and the second group was given on Wednesday, the week following, and repeated on Friday.

The classes were divided into squads, a squad never more than 15 women. All women wore regular gymnasium costume of knickers, shirt, and shoes. The tests were not announced, so there was no opportunity for practice. Tests were repeated at the next class period to eliminate possibility of practice between first and second time.

Records were taken by class instructors, who had previously been given adequate and detailed explanation of the tests to be given and the exact procedure to be used in administering them. Also the directors of each test were given typed directions for that particular test. Two operators were constant throughout and the third operator in each class was the class instructor. This reduced the number of operators to seven. By this procedure chances for personal errors were reduced to a minimum. The administrative procedure for each test is as follows:

50-yard dash.

This event was conducted as it would be in a track and field meet. The women were allowed to stand or crouch at the start. Three women ran at one time. A whistle was used to indicate the command of "go." Only one trial was allowed. The score was the time in fifths of a second.

Change Balls.

Twenty standard la crosse balls were placed in a cardboard box so that all the balls lay on the bottom. A second box of the same dimensions was placed 3 feet to the right of the first box. Both boxes were fixed so that they would not slide and were placed at the edge of a three-foot platform. The balls were changed one at a time from one box to the other by taking them from the box with the left hand, changing them to the right hand and placing them in the other box. The score was the number changed to the second box in 10 seconds.

Standing broad jump.

This was run as any standard jumping event. A toe board was provided and the student jumped onto a mat marked in feet and inches. Two trials were allowed and the best jump measured to the nearest inch was recorded as the score.

Jump and Reach.

A blackboard marked in inches and half inches was attached to a perpendicular ladder which stood out about a foot from the wall. The board was fastened so that the lower edge was five feet from the floor. Each student wet her finger tips from a sponge and stood facing the blackboard. From a standing position she reached upward as high as possible and made a mark. Then from the same position she jumped as high as possible and made another mark. She was given one trial jump and her score was recorded as the distance between her reach and her jump to the nearest half inch.

Hand Dynamometer.

The student gripped the hand dynamometer up to 25 pounds and repeated as many times as possible. The hand and arm were kept entirely free from the body. The number of times she raised the dynamometer to 25 pounds was her score.

Walk Balance Beam.

Four balance beams one-half inch wide and ten feet long were notched and placed end to end so that they could not slide apart. The student placed one foot in front of the other, heel to toe, and walked as far as possible. The number of feet she walked equalled her score.

Bend High Hang.

A high beam was placed at such a level that the student could stand on a bench and come to the bend high hang position. With arms bent and chin on or above the level of the bottom of the bar, the student hung from the high boom as long as possible. The chin was not allowed to rest against the bar. The time, taken from the command "go" until the chin fell below the level of the bar, was the score.

Baseball Throw for Distance.

Twelve-inch outseam playground balls were used. Two throws were allowed and the best throw measured to the nearest foot was the score. The field was marked every five yards over a distance of twenty yards and every five feet over a distance of thirty yards. Cards with the number of feet marked were placed at the end of each line.

Ball Roll.

Standard 12-inch playground balls were used. Three Indian clubs were set up at intervals of 1 foot. Balls were rolled from a restraining line 25 feet from the clubs. Five rolls were allowed and the number going between the clubs was the score.

Baseball Target Throw.

Twelve-inch outseam playground balls were used. A circular target 2 feet in diameter was divided into equal thirds, the three divisions being scored 5-3-1 respectively from the center outward. Three throws were allowed and the score added to obtain the final score. An underhand throw was used and the pitcher's line was 20 feet from the target.

Through the Window Ladder.

A starting line was placed 3 feet from the window ladder. At the command "go," the student started from the starting line, climbed up through three windows and down through the same three windows and returned to the starting line as fast as she could. The time, taken from the command "go" until the student returned to the starting line, was the score. No particular form was required for going through the ladder.

Through the Stick.

An ordinary wand was used and the stunt directions as found in the Oregon State Point System were followed. The time was taken from the command "go" until the upright position was resumed. If the student did not succeed the first time she immediately tried again and the time taken for both trials was her score. If she did not succeed in two trials she did not receive any score for this test.

Trunk Bend.

A 750-pound double resistant scale was attached to the stall bars by means of leather straps. A canvas strap 3 inches wide was fastened to the other end of the scale in such a way that the loop could easily be slipped over the head and under the arms. A low horse was placed in front of the stall bars so that the hips could be braced against it. The student stood with the hips braced and bent the trunk forward against the resistance of the scales. The number of pounds registered on the scale was recorded as the score.

Tapping.

The motor rhythm synchrometer which was used for the tapping test is described in detail in the Stanford Motor Skills unit by Robert Seashore.[10] The apparatus is fairly simple to make and is one which may be obtained by any department of physical education. The test was administered by a graduate student of psychology who was familiar with the apparatus and the procedure involved.

The apparatus was placed in a small room adjoining the gymnasium so that there would be no distracting influences and so that noise from the play field and other parts of the building could not be heard.

The test was given for one minute only and in rare cases a second trial was given—if, for example, the girl was not holding the key correctly. The score was recorded as the number of correct taps in the one minute trial.

Directions for Giving Tests

AT the beginning of class the roll was called by squads from the score cards and for each event the class lined up in these squads in the regular order.

The first test given was the *50-yard* dash in which three girls ran at one time, and three more, and so on. Directions for giving were: "At the sound of the whistle run as fast as you can until you pass the timer. The command will be, 'on your mark—get set—whistle.' Your time will be your score."

The second test was the *baseball throw for distance*. The last girl in each squad stood opposite her squad to pick up the balls and each girl then picked up the balls for the following girl. A sufficient number of balls were provided so that there would be no delay in throwing. Directions for giving the test were: "Stand back of the restraining line and throw the ball as far as possible. You are allowed one step in throwing. You are to have two throws and the best throw measured to the nearest foot will be your score. Throw each ball as called."

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10 Robert Seashore, *loc. cit.* pp. 51-66.

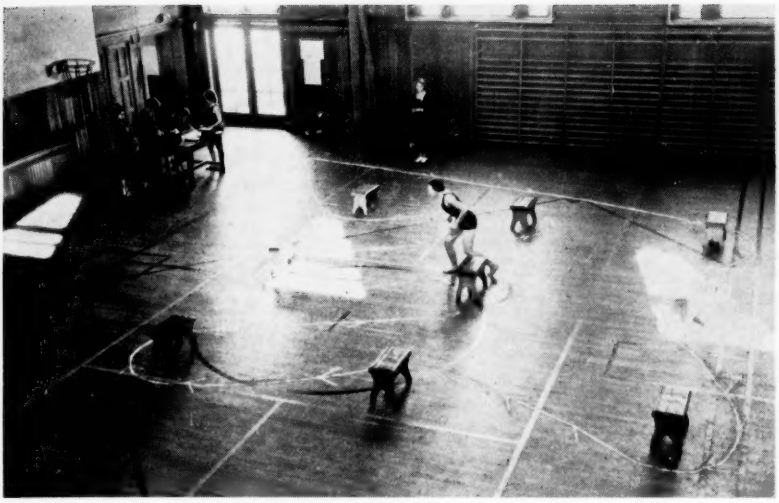

Fig. 1—Forty Yard Maze Run

The student, as she enters the gymnasium, goes to the clerk at the table, who makes out her card (see p. 115). This is given to the girl, who hands it to the operator. At the end of the run, the operator enters her card and carries it to the operator of the next event. When she has completed all four tests, she returns her card to the clerk's assistant who enters the percentile weights, foots up the total on the adding machine, enters her classification and gives the girl a slip stating whether she is to enroll in "Novice" or "Regular" work. See Diagram 1, page 97; also Appendix 1, for description.

Fig. 2—Jump and Reach

The student, after wetting her finger on the sponge, makes a mark on the board as high as she can reach. She toes the line in any way that seems easiest to her and jumps as high as she can, making another. Her raw score is the difference between the two marks. The ladder protrudes from the wall and the girl stands at the side in order to eliminate fear of hitting the ladder as she jumps. See Appendix 2 for description.

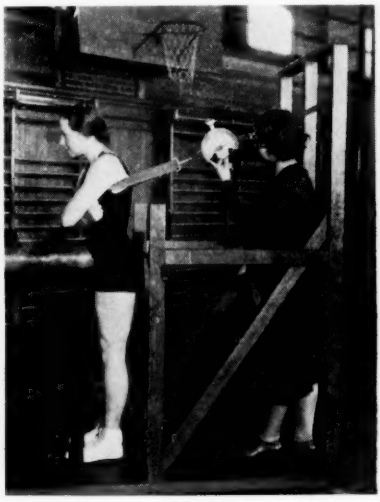

Fig. 3—Trunk Bend

The operator enters from the rear. From this point, she can easily adjust the height of the board against which the student braces herself, can buckle the strap around the girl's chest and raise or lower the strap by the pegs on the upright in order to obtain the best angle of pull. There are two hands on the face of the scales, one of which stays at the highest point, thus reducing mistakes in reading. The raw score is registered by the indicator. See Diagram 1, also Appendix 3, for description.

Op
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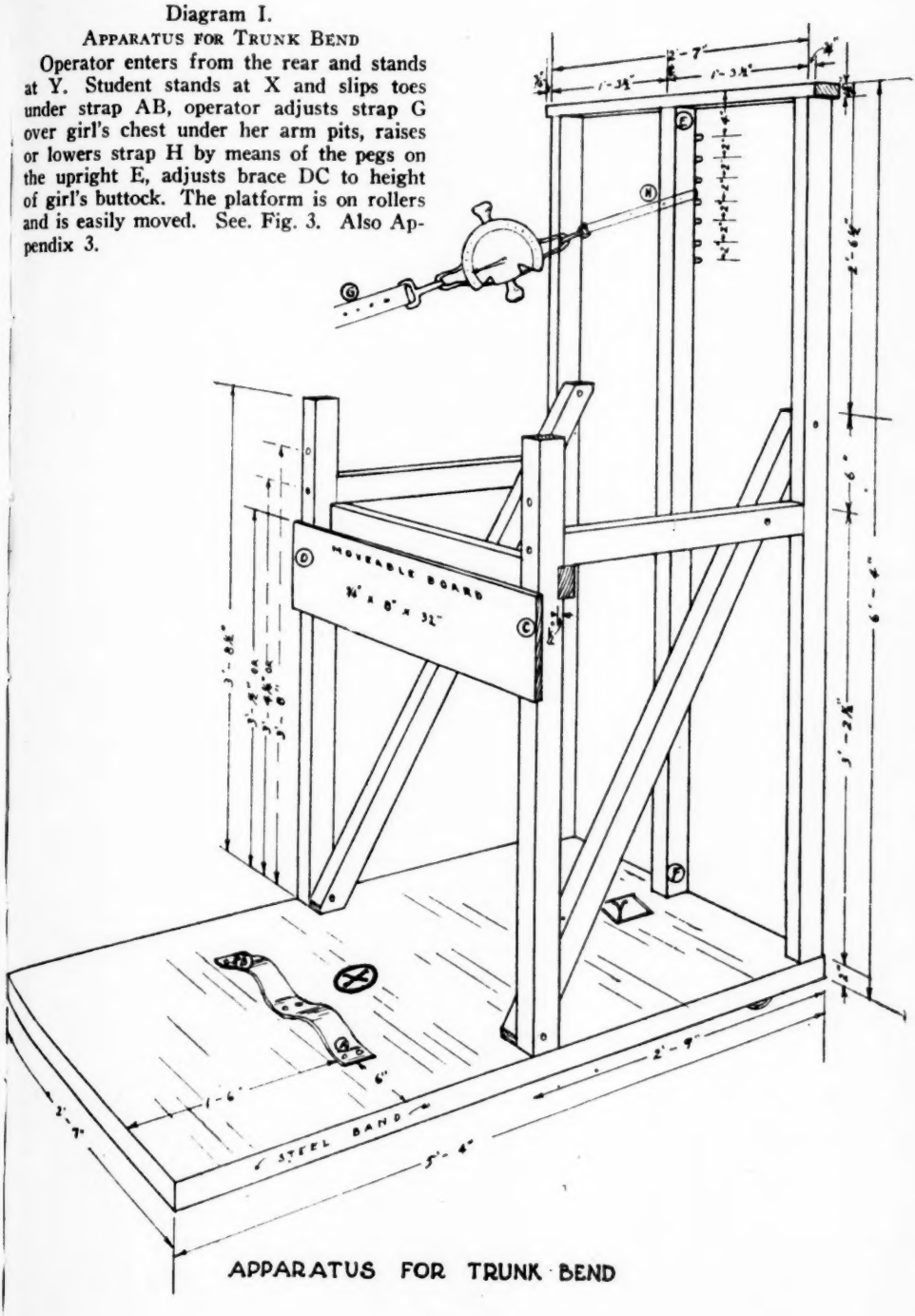
Diagram I.

APPARATUS FOR TRUNK BEND

Operator enters from the rear and stands at Y. Student stands at X and slips toes under strap AB, operator adjusts strap G over girl's chest under her arm pits, raises or lowers strap H by means of the pegs on the upright E, adjusts brace DC to height of girl's buttock. The platform is on rollers and is easily moved. See. Fig. 3. Also Appendix 3.



APPARATUS FOR TRUNK BEND

The third test was the *bend high hang.* The three squads lined up at the boom and received the following directions: "Stand on the bench and with arms bent grasp the boom, palms facing you and chin on a level with the bar. At the command 'go' hang in this position as long as possible. Time will be taken from the command 'go' until your chin falls below the level of the bottom of the bar. Do not touch your chin to the bar." This test was demonstrated.

The fourth test was *through the window ladder.* The three squads lined up as before and received the following directions: "Stand with both feet back of the restraining line. At the command 'go' run to the ladder, climb up through three windows and down through the same three windows and return to the starting line. Time will be taken from the command 'go' until you return to the starting line." This test was demonstrated.

After the above four tests were given each squad went to a different test and rotated until all tests were given to them.

Directions for the *baseball target throw* are as follows: "Start with both heels on the line. Use an underhand throw and try to hit the center of the target. The center counts 5, next 3, and outside counts 1. You will be allowed three throws and the scores added to obtain your final score. You are allowed one step in throwing."

Directions for *standing broad jump* are as follows: "Stand with your toes on the edge of the board and jump as far as you can. You are allowed two jumps and your best jump will be recorded as your score." This test was demonstrated.

Directions for *jump and reach* are as follows: "Wet your finger tips, face the blackboard, reach up as high as possible and make a mark. Wet your fingers again and from the same position jump as high as possible and make a second mark. You will be given one trial jump. Your score is the distance between your reach and your jump to the nearest half inch." In many cases the student did not wish to take a trial jump so this was not insisted upon. This test was demonstrated and explained simultaneously. Fig. 2.

Directions for the first four tests were given to the entire group at one time by one operator and each tester then gave her own commands. For the other three tests each tester gave the directions. The rotation by squads was as follows: I. From the broad jump to the jump and reach and then to the baseball throw; II. from the jump and reach to the baseball throw and then to the broad jump; III. from the baseball throw to the broad jump and then to the jump and reach.

This rotation was set up according to the time it took to give each test. Also an orderly established rotation would prevent any person from not taking a test.

Some difficulty was encountered in making an orderly rotation for the second group of tests because the tapping test for rhythm took considerable time to administer.

Directions for giving each of the tests are as follows:

Change Balls.

"Take the balls one at a time from the box, using your left hand, place them in your right hand and then in the other box. Your score will be the number in the second box at the end of ten seconds." This test was demonstrated.

Hand Dynamometer.

"Grip the dynamometer in either hand until the hand goes up to 25. Repeat as many times as possible, pushing the hand back to zero after each grip. Keep the hand and arm entirely free from the body. The number of times you raise the hand to 25 equals your score." This test was demonstrated.

Walk Balance Beam.

"Walk the balance beam, placing one foot in front of the other, heel to toe. The number of feet you walk equals your score."

Ball Roll.

"From the restraining line roll five balls one at a time between the clubs. The number going between will be your score." One girl picked up and returned the balls.

Through the Stick.

"Grasp the wand with both hands behind the back, palms forward. Lift over your head to front of body and put your right foot around the right arm and from the front put foot over the stick between the hands. Crawl through head first by raising the stick with the left hand over the head and by skinning the stick over the right knee in the back. Come to an upright position and step back over the stick with the left foot, finishing with the stick still in both hands. You may do this on the left or right side. Time will be taken from the command 'go' until the upright position is resumed." This test was demonstrated twice and explained twice.

Trunk Bend.

"Stand with your hips against the horse. Place the strap just under your arms. Keeping your hips against the horse and your feet still, bend your trunk forward as far as possible. The number of pounds equals your score." Fig. 3—Diagram 2.

Tapping.

"In this test you are to tap exactly in time with this telegraph sounder. It will sound these four notes over and over again (illus-

trate) and it will always be the same. You are to hold the telegraph key in this manner (illustrate) so that your first finger is on top of the key and it is held between the thumb and second finger. Your score will be the number of taps you are right within .05 second of the exact time of the sounder. The sounder will run for one minute. You are to start tapping when the sounder does and stop when it does. You will be allowed a few rounds in which to get started before your score begins on the counter. Remember to keep exactly in time with the sounder, just as you would in an orchestra."

CHAPTER III

Statistical Examination of the Test

NO criterion of general motor ability has yet been worked out for college women, so it is necessary to show that the one chosen—the composite score in 14 tests under consideration—is a logical one. The composite score in these 14 tests shows the sum of the individual's efforts on a large number of different motor tests involving almost all types of motor activity, so it gives a fairly complete estimate of a girl's motor equipment.

Criteria for Validity

It has previously been shown that judges in the field of physical education believe that general motor ability is made up of the following elements: speed, strength of legs, endurance, balance, arm and shoulder strength, arm and shoulder coordination, accuracy, agility, flexibility, abdominal strength, and rhythm. This judgment rating has been taken as the basis for the separation of the general quality of motor ability into separate parts for the grouping of tests.

As a second criterion the correlation between two performances of the same test was obtained. Rugg[11] says the correlation between the two performances of the same test, if .50, .60, or above indicates that the scores are accurate measures of the ability in question. Table III shows the reliability coefficients of all the tests.

It will be noted from the table that the two tests under accuracy have a very low reliability coefficient, .22 and .15. Accuracy involves too many factors for reliable measurements with these tests, therefore, while it is an important element, the use of such measures would contribute little which would be of value.

As a third criterion the correlation between the separate elements and the composite score was obtained. For purposes of comparison it is necessary to turn raw scores into scores which are comparable for each event. That is a score of 60 in one event should represent the same position in the scale of ability as a score of 60 in another

11 H. O. Rugg, *Statistical Methods Applied to Education*, (1917), 256.

TABLE III

RELIABILITY COEFFICIENTS OF INDIVIDUAL TESTS

		No. of Cases	Self r.	P E r.
I.	Speed			
	50-yard dash	129	.66	.03
	Change balls	71	.54	.06
II.	Endurance			
	Hand dynamometer	77	.56	.05
III.	Strength of legs			
	Standing broad jump	125	.83	.02
	Jump and reach	123	.87	.01
IV.	Balance			
	Walk balance beam	77	.45	.06
V.	Arm and shoulder strength			
	Bend high hang	132	.87	.01
VI.	Arm and shoulder co-ordination			
	Baseball throw	132	.65	.03
VII.	Accuracy			
	Ball roll	71	.22	.08
	Baseball target throw	119	.15	.07
VIII.	Agility			
	Through window ladder	131	.69	.03
IX.	Flexibility			
	Through the stick	57	.69	.05
X.	Abdominal strength			
	Trunk bend	77	.75	.04
XI.	Rhythm			
	Tapping	77	.37	.07

event. Also in order to add the scores of the single tests and obtain a composite score of the individual's ability the scores must be comparable. For this purpose the T-scale was used.[12] Table IV shows the correlation of the separate tests with the composite score.

TABLE IV

CORRELATION OF SEPARATE TESTS WITH COMPOSITE SCORE

	r.	P E r.
50-yard dash	.69	.03
Change balls	.50	.05
Standing broad jump	.70	.03
Jump and reach	.60	.04
Hand dynamometer	.35	.05
Balance beam	.35	.05
Bend high hang	.70	.03
Baseball throw	.50	.04
Through window ladder	.37	.05
Through the stick	.28	.06
Trunk bend	.44	.05
Tapping	.08	.06

12 David Brace, "A Method of Constructing Athletic Scoring Tables," *American Physical Education Review*, April, 1924.

As a fourth criterion the test scores were compared with the test scores made by 14 athletes highly specialized in motor activity. If the tests are valid the average T-scores for the athletes should be considerably higher than the average T-scores for the ordinary group. This is shown to be the case by the following data. Table V shows the average T-scores made by the athletes on 10 tests compared with the average T-scores made by the ordinary group on the same 10 tests.

TABLE V

AVERAGE T-SCORE OF ATHLETES AND AVERAGE T-SCORE OF ORDINARY GROUP

	Athletes	*Ordinary Group*
50-yard dash	61	49
Change balls	55	48
Standing broad jump	64	50
Jump and reach	65	51
Balance	54	53
Bend high hang	56	51
Baseball throw	67	55
Through window ladder	67	55
Through the stick	51	48
Trunk bend	56	50

Three previous studies in the field of physical tests have used a composite score on a short battery of athletic ability tests as one of the criteria for establishing the validity of tests. Brace's[13] second type of criterion was the scores on a variety of athletic events. He found that the largest coefficient .70-.80 was obtained when the largest number of events was included in the criterion. Rogers[14] and Cozens[15] also used the composite score on a number of events as partial criteria and obtained a very high coefficient of correlation.

In addition to the criteria previously used by Brace, Rogers and Cozens, a fifth criterion, also used by Cozens, will be used to show the value of the composite score on a number of events as a criterion of general motor ability. This is by means of the judgment ratings of the class instructors. Judgments were secured from instructors in beginners' classes of tennis, hockey, canoeing, dancing and swimming. The instructors were asked to rate their girls in order of merit according to their ability in tennis, swimming, or whatever they were taking. "1" represented the best, and so on down. From these judgments the coefficient of correlation of the criterion score was computed. Table VI shows the coefficient of correlation of the criterion score for each class rated, when correlated with the composite score.

13 D. K. Brace, *loc. cit.*, Chapter III.
14 F. R. Rogers, *loc. cit.*, Chapter IV.
15 F. W. Cozens, *loc. cit.*, Chapters III, IV.

TABLE VI

CORRELATION OF CRITERION SCORE IN EACH ACTIVITY WITH COMPOSITE SCORE

	r.	P E
Beginning tennis	.60	.10
Beginning hockey	.58	.10
Beginning canoeing	.60	.10
Beginning dancing	.50	.11
Beginning swimming	.54	.11

In an effort to determine if possible what sports contributed most to success in the separate events the judgment ratings in beginning tennis and beginning dancing were correlated with the separate events of the test. Tables VII and VIII show the coefficient of correlation of the criterion score in the two mentioned classes, when correlated with the separate tests.

TABLE VII

RELIABILITY COEFFICIENTS OF CRITERION SCORE IN BEGINNING TENNIS

	r.	P E
50-yard dash	.45	.12
Change balls	.33	.10
Standing broad jump	.40	.13
Jump and reach	.63	.09
Hand dynamometer	.32	.14
Balance beam	.23	.14
Bend high hang	.30	.15
Baseball throw	.21	.14
Through window ladder	.61	.10
Through the stick	.02	.14
Trunk bend	.50	.11
Tapping	.04	.15

TABLE VIII

RELIABILITY COEFFICIENTS OF CRITERION SCORE IN BEGINNING DANCING

	r.	P E
50-yard dash	.40	.13
Change balls	.51	.11
Standing broad jump	.08	.15
Jump and reach	.30	.14
Hand dynamometer	.46	.13
Balance beam	.07	.15
Bend high hang	.30	.14
Baseball throw	.53	.10
Through window ladder	.33	.13
Through the stick	.32	.16
Trunk bend	.76	.05
Tapping	.07	.15

There are seemingly two reasons why the coefficients of correlation of the criterion score when correlated with the separate tests

are low in many tests. In the first place, coefficients of correlation based on twenty or less cases are only indicative of correlations and may not be used as final evidence. Secondly, the ratings given were in order of merit instead of units of score and thus did not represent the same position on the measuring scale. In order for the evidence to be of practical value the correlation should be based on hundreds of cases rated in units of score.

It seems logical to assume that a composite score on the elements of general motor ability is a good criterion by which to judge the validity of tests of motor ability, because:

1. The elements of general motor ability as chosen represent the combined judgment of a number of qualified people in physical education, and the tests chosen represent almost all types of motor activity.
2. The test scores are accurate measures of the ability in question.
3. The separate tests have a high correlation with the composite score.
4. The scores made by students of high athletic ability are very high compared with the average group.
5. Three recognized studies in the field of physical education have used athletic tests as partial criteria.
6. A judgment rating given 88 women in different classes correlated from .50 to .60 with the composite score of these women.

Selection of Battery

For purposes of administration it is highly advisable to select a short battery of tests. This battery should consist of those tests which have the highest self correlation, the highest correlation with the composite score, and the highest correlation with the criterion. It may be noted from Tables III, IV, VII, and VIII that those tests which have the highest self correlation, the highest correlation with the composite score, and the highest correlation with the criterion are as follows:

Test	*Self r.*	*r. with Composite Score*	*r. with Criterion*
50-yard dash	.66	.69	.45
Jump and reach	.87	.60	.63
Bend high hang	.87	.70	.30
Baseball throw	.63	.50	.53
Through window ladder	.69	.37	.61
Trunk bend	.75	.44	.76

A usable battery of tests for a department of physical education must contain also those tests which allow for ease and speed of administration. For this reason tests that involve two or three

trials, such as the standing broad jump, would be of less value in a short battery than other tests which measure the same thing but do not take so long to administer. From these points of view then the best battery of tests would be:

50-yard dash	Baseball throw
Jump and reach	Through the window ladder
Bend high hang	Trunk bend

One objection which may be made to this battery is that part of it must be given outdoors and thus it cannot be used in rainy weather. However, the month of September in this country is fairly free from rains, and most of the testing will be done at that time. A substitute battery to be used in case of impossible outdoor weather may be suggested as follows:

40-yard maze run	Change balls
Jump and reach	Through the window ladder
Bend high hang	Trunk bend

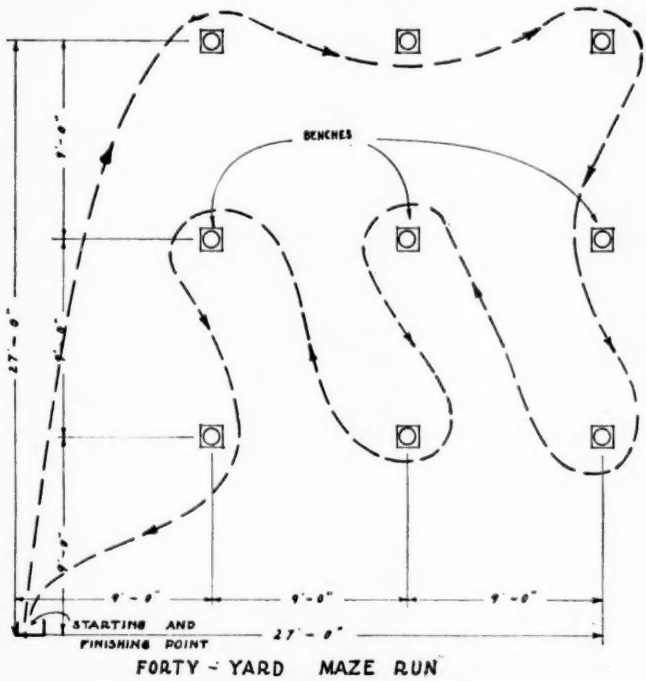


Diagram II—Forty Yard Maze Run

The student toes the line at the starting point. At the signal given by the operator she starts running along the chalk line in the direction indicated by the red arrows, and finishes at the same point. See Fig. 1, p. 97a. Also Appendix 1 for description and directions.

CHAPTER IV

Retest of Battery

IN order to make the study more complete and with a view to using the test to classify the entering freshmen women at the University of Oregon, the battery was subjected to further study and testing, the scope of which was to:

1. Recheck and retest the self correlation of the separate elements of the test.
2. Correlate the motor ability test with the composite score of five terms of grades in physical education.
3. Correlate the motor ability test records of 1928-1929 with those of 1929-1930.
4. Correlate the motor ability test records of 1929-1930 with the scores on objective achievement tests given the same year.
5. Determine if possible the diagnostic value of the test and see if it will indicate with some degree of accuracy based upon scientific background, just what type of physical education should be offered to the student who is weak in certain elements of the test.

The substitute battery was used as the weather was not suitable for outdoor testing.

People Tested

The tests were given to three hundred eleven girls at the beginning of winter quarter of 1929-30 and were repeated by one hundred forty-nine girls at the end of winter quarter of the same year. Two hundred forty-four of the girls were freshmen and sophomores taking required physical education, the other sixty-seven were majors in the School of Physical Education.

Administrative Changes

In the retests the second and third year, some slight changes were made.

The second year the entire test was given in one class period and the third year it formed a part of the physical examination given before classes start in the fall.

The one different event, the 40-yard maze run, is described in the appendix.

It was found more accurate to double the time in the ball change which necessitated doubling the number of balls and increasing the size of the right hand box. The box was also made deeper to prevent the balls bouncing out. As lacrosse balls are expensive, Eagle Brand 31 tennis balls were substituted at a cost of $1.10 a dozen. Fig. 4, page 97a. Appendix 4.

A permanent frame was made for the trunk bend which makes possible a more accurate adjustment to the varying heights and the standardizing of the angle of pull. Diagram I, page 97. Fig. 3, page 97a. Appendix 3.

Directions for giving tests may be found in the appendix.

Additional Criteria for Validity

The first criterion for validity on the battery retest was the further establishment of the reliability of the tests. Table IX shows the reliability coefficients of the tests given in 1928-29 as compared with those given in 1929-30.

TABLE IX

RELIABILITY COEFFICIENTS OF INDIVIDUAL TESTS IN 1928-29 AND 1929-30

	1928-29			1929-30		
	No. of Cases	Self r.	P E r.	No. of Cases	Self r.	P E r.
50-yard dash	129	.66	.03			
40-yard obstacle race				149	.68	.03
Jump and Reach	123	.87	.01	149	.79	.02
Bend high hang	132	.87	.01	149	.75	.02
Change balls	71	.54	.06	149	.41	.04
Through window ladder	131	.69	.03	149	.69	.03
Trunk bend	77	.75	.04	149	.65	.03

For purposes of comparison the T-scale score was used as before, the distribution being made from the combined scores of the tests given in 1928-29 and 1929-30. The frequency therefore was 460.

Table X shows the correlation of the separate tests with the composite score for 1928-29 and 1929-30.

TABLE X

CORRELATION OF SEPARATE TESTS WITH THE COMPOSITE SCORE FOR 1928-29 AND 1929-30

	1928-29		1929-30	
	r.	P E r.	r.	P E r.
50-yard dash	.69	.03		
40-yard obstacle race			.69	.02
Jump and Reach	.60	.04	.57	.03
Bend high hang	.70	.03	.69	.02
Change balls	.50	.05	.62	.02
Through window ladder	.37	.05	.64	.02
Trunk bend	.44	.05	.65	.02
	N-149		N-311	

It will be observed that in every case in the above table the probable error was lowered .01 to .03. This was probably due to the increase in the number of cases and the larger range of the scores made on the test.

The second criterion for validity on the battery retest was the correlating of the physical ability test records of 1928-29, and the composite of five terms of grades in physical education. The result was:

r. ..... .62 P E r. ..... .04

The third criterion was the correlation of the physical ability test records of 1928-29 with those of 1929-30. As only two years of physical education is required at the University of Oregon, all sophomores taking the test in 28-29 would not take the test in 1929-30, therefore, the correlation was made on forty cases. With such small numbers the coefficient of correlation would only be indicative that some correlation did exist. The coefficient of correlations between the physical ability test records of 1928-29 and those of 1929-30 was:

r. ..... .47 P E ..... .08

The probable error is fairly large, nevertheless it is still within the limits of four times the P. E. being less than r. Garrett says that four times the P. E. should be less than r. if r. is to be of any value.[16]

The fourth criterion was the correlation of the motor ability test records of 1929-30 with scores gained in objective achievement tests in the separate activities. These tests are built up of the elements of the sport taught and are used to measure improvement and as a part of the final grade. The activities chosen were: (1) moderate sports and stunts (2) basket ball (3) dancing (4) swimming. Table XI shows the coefficient of correlation between the motor ability test and the achievement tests.

TABLE XI

CORRELATIONS—MOTOR ABILITY TESTS WITH ACHIEVEMENT TESTS

			Beginning of Term
1.	Motor test and composite achievement score	r. .364	P E ± .06
			End of Term
2.	Motor test and composite achievement score.....	r. .320	P E ± .03
3.	Motor test and achievement score in:		
	Basketball	r. 48	P E ± .04
	Dancing	r. 20	P E ± .06
	Swimming	r. 72	P E ± .06
	Moderate sports	r. 24	P E ± .05

[16] H. E. Garrett, *Statistics in Psychology and Education*, (1926), p. 170.

The low correlations may be due to one or all of the following reasons:

1. These tests are in the experimental stage and have not yet been well standardized.
2. The students realized that the motor ability score did not affect their grades but that the achievement test was a part of their final examination in that activity.
3. This is further evidenced by the fact that on the scattergram, the greatest deviation was found in the upper quartile in which the low motor scores and high achievement scores fell. Very few extreme scores are found in the lower division where the high motor test scores and low achievement scores fell.
4. Those achievement tests that are the most objective and have been standardized the best, correlated the highest.
6. The number of cases was so small that the resulting correlations merely indicate that there is some relation.

Diagnostic Value of the Test

THE purpose of this digression was to see if the test really measured slight differences in the performance of the separate elements of the test after a student had finished one term of physical education at the University of Oregon.

The test was given, as described, during the first two weeks of winter quarter and the last two weeks of the same quarter. During the time which elapsed between the first testing and the second testing, the girls were given physical education in one of three different types of physical activity: moderate sports and stunts, basketball, or dancing.

The correlation was computed between the first and second trials in each activity for each element of the test. The averages and the standard deviations were calculated in order to reveal any slight difference that moderate sports and stunts, basketball, or dancing might have on the different elements of the test. As noted the self correlation seems to indicate that the test is measuring some constant quality. This constant quality shows a rise in the mean and a decrease in the sigma in all but two or three cases which show a slight decrease in the mean. Table XII shows the self correlation of the physical ability test elements given at the beginning and end of winter quarter in each of the three activity classes.

TABLE XII

CORRELATION—MODERN SPORTS AND STUNTS WITH

	r.	P E r.
40-yard maze run	.81	.04
Jump and reach	.74	.05
Bend high hang	.35	.11
Change balls	.75	.05
Through the window ladder	.40	.10
Trunk bend	.63	.03
Composite score	.45	.10
BASKETBALL WITH		
40-yard maze run	.56	.06
Jump and reach	.58	.08
Bend high hang	.75	.04
Change balls	.5	.08
Through the window ladder	.84	.03
Trunk bend	.16	.10
Composite score	.63	.06
DANCING WITH		
40-yard maze run	.75	.04
Jump and reach	.66	.05
Bend high hang	.82	.03
Change balls	.77	.04
Through the window ladder	.61	.06
Trunk bend	.79	.04
Composite score	.57	.07

Table XIII shows the differences in the mean and sigmas as computed by subtracting the averages and standard deviations on the tests given at the beginning of the quarter against the tests given at the end of the quarter.

TABLE XIII

CHANGES IN MEANS AND SIGMAS

Moderate Sports and Stunts		*Increase*	*Decrease*
40-yard maze run	Av	5.80	
	SD		.75
Jump and reach	Av	4.10	
	SD	.30	
Bend high hang	Av	1.56	
	SD	1.85	
Change balls	Av	3.90	
	SD	1.50	
Through window ladder	Av	.68	
	SD		.45
Trunk bend	Av	5.67	
	SD		.95
Composite score	Av	16.51	
	SD		.30

		Increase	Decrease
Basket Ball			
40-yard maze run	Av	3.83	
	SD		.60
Jump and reach	Av	4.10	
	SD		1.10
Bend high hang	Av	2.45	
	SD		1.45
Change balls	Av	1.94	
	SD	2.20	
Through window ladder	Av	3.38	
	SD		1.40
Trunk bend	Av	5.31	
	SD		.30
Composite score	Av	15.01	
	SD		.25
Dancing			
40-yard maze run	Av		4.00
	SD	1.50	
Jump and reach	Av	.50	
	SD		.00
Bend high hang	Av		3.80
	SD	1.50	
Change balls	Av	.40	
	SD		1.00
Through window ladder	Av	6.10	
	SD		.70
Trunk bend	Av	7.50	
	SD	.35	
Composite score	Av	33.95	
	SD		.00

In calculating the averages of the motor test and elements given at the first of the term with the motor test and elements given at the end of the term, it was found that the average increased from .01 to 7.50 points in all cases except two. Such a result consistently obtained would tend to indicate that in all of the classes of physical education some muscular strength and coordination had been acquired in that one term of physical activity. In most of the cases the sigma was lowered, which pointed out that the group as a whole was less variable.

Basketball classes, which usually require a great deal of muscular strength and endurance, are most likely to be chosen by the athletic type of girl. Dancing and moderate sport classes, on the other hand, are nearly always chosen by the artistic girl who is often muscularly weak. As the chart in Table XIII seems to point, such a type of girl would have greater possibilities of physical development than the girl already muscularly strong. In this same chart it is interesting to note that in the basketball class the total jumping ability of the whole class increased 4:10 and individual abilities drew closer

together as shown by the decrease in the sigma of 1.10. The greatest increase of total class average is to be found in the dancing class—an increase in abdominal strength of 7.50. This might be assumed to indicate that dancing strengthens the abdominal muscles more than either moderate sports or basketball, except for the fact that the basketball group's initial strength was as great as the dancing group's final strength, and still they increased their average 5.31. Such inferences seem to indicate that the dancing group as a whole was the weakest group in physical ability, but also indicates that this same group made the greatest progress in acquiring muscular strength.

These results would suggest a line of further study to determine if the test might not be used for diagnostic purposes in the prescription of work suited to each individual.

CHAPTER V

Percentile Ranking and Norms

AS has been indicated earlier, it was necessary to transmute the raw scores of these tests into some form of positive score since in the case of some tests, a small score meant excellence in the test, while in others a small score meant the lack of excellence. The scores used the first two years were T-scores. Some difficulty was found with these, of the type which is inherent in them, namely, they were not very satisfactory as accurate indices of ability at either the upper or the lower range of the distribution of scores. The percentile ranking system is in common use at the University for recording psychological ratings, English test ratings and other measures. So it seemed desirable to use the latter type of score because the universality of its present use makes it the type of score which is most readily interpreted.

Likewise during the first two years no attempt was made to evaluate the battery of tests in terms of the value of each individual member of the battery as a predictive measure. After the entering girls were tested by the battery in the fall of 1930, it seemed there would be sufficient data available for the evaluation of the different parts of the battery and for the changing of the former score from T-scores to the percentile rank scores.

It was very difficult to find a suitable criterion for purposes of evaluating the different tests in the battery. Several possible ones were tried, among which were objective tests in the specific activities in which the girls had enrolled and participated during the year, such as swimming, tap dancing, tennis, fencing, the novice activities, etc. In each of these criteria the element of teaching necessarily became a considerable factor since the tests were not ordinarily given until

the end of a quarter's participation in any activity. Likewise, special abilities were apt to be brought out by teaching, which again limited the value of such criteria. The fact that some such conditions were present was found at once when correlations were run between scores on these final tests and the activity tests.

The most desirable criterion seemed to be the judgment of instructors concerning the motor ability of the students, when that judgment was based upon the several factors which had been collected through correspondence with other physical directors and which these physical directors had indicated in their judgment as being the essential elements of motor activity. The collection of these judgments has been described earlier in the paper so it is unnecessary to go into that phase of the matter now.

From among the elements of motor ability which had been offered it was decided to take agility, strength, rate of learning, endurance and speed as being elements which were not over-lapping and upon which judgment could be based with a fair degree of accuracy by the members of the staff of the Women's Physical Education Department. These members of the staff were asked to rate the girls they knew best according to the following instructions:

Each member of the staff was to select an individual from the present year class whom she considered outstanding in a particular element such as coordination, and use that individual as a criterion for rating each of the other individuals. These ratings were based upon the score 1, 2, 3, 4, or 5; five indicating ability in that element equal to the individual used as the criterion.

By this method it will be noted that each instructor used a different standard of excellence as a criterion, but this was deemed necessary because of the fact that no definite criterion was available and because the instructor, left to herself in setting up criteria, would probably have varied more in her selection than the class itself would vary.

They were likewise asked to make their judgments irrespective of the activity in which the student happened to be engaged. Judgments were to be based only upon freshmen, thus eliminating all transfer students who would have had a possibility of having greater training than freshmen. These judgments when obtained were used as criteria against which the motor activities test was correlated by multiple correlation technique in order to determine the relative weights or values of each member of the battery as a measure for prediction. By this method it was found that only four of the seven tests were measuring discrete factors which it was desirable to measure, hence the battery could be reduced to four parts by retaining the Ball Change test, Maze Run test, Trunk Bend test and the Jump Reach test. Anything measured by the other three parts of

the battery was apparently measured by one or more of these four tests, since they added nothing to the value of the multiple correlation coefficient. Then with the three tests eliminated and a battery of four as the final measure, the relative weights of the four remaining tests were determined. They were found to be as follows:

Ball Change	4	Trunk Bend	1
Maze Run	1	Jump Reach	2

Scores in terms of percentile ranks serve very well as norms and at the same time are norms which are easily reestablished each year on an increasingly reliable basis by simply combining the frequency distributions of the newly entering class with those of classes which entered previously and transmuting these combined distributions into new percentile ranks. The percentile ranks established on this basis become in time highly reliable and at the same time fairly reliable norms are available at the beginning of the second year for use in immediate classification of students as they take the activity test.

Use of the Test in Its Present Form

TO facilitate the use of percentile ranks as norms and to facilitate classification of the students as they took the tests, a record card and a table of equivalents were worked out as follows:

The record card is so arranged and spaced that for each test of the battery the raw score, the percentile rank equivalent of that score, and a weighted equivalent of that score can be recorded. The percentile rank equivalent is to be used as the norm by which the student will be judged as to her success in each individual test. The weighted equivalents are to be combined and used to determine the percentile rank of the individual on the basis of her achievement on the whole battery.

The table of equivalents is so arranged that as soon as the score for an individual test is known, the percentile rank equivalent and the weighting for use in the total battery may be read off at once and recorded. After the scores for all four tests of the battery have been recorded in this way it is only necessary to sum up the four weightings recorded on the card and find its percentile rank equivalent in the last column of the table of equivalents. This percentile rank represents the classification of the student on the basis of the whole battery. The whole process of recording, summing up, and entering the final percentile rank is a matter of seconds rather than of minutes.

A sample card and the portion of the table of equivalents which it involves is shown below.

RECORD CARD

Name *Smith,* *Ruth* *Anne* Test P. R. *53*
Last, *First,* *Middle* Classification: *Regular*
Retest P. R.

School of Physical Education—Department for Women

MOTOR ABILITY CLASSIFICATION TEST

Class *1936* Date *9-29, 1932* Date ....., 19....

	TEST			RETEST		
	Raw Score	Percentile	Weight	Raw Score	Percentile	Weight
Change Balls (no.)	*24*	*.404*	*1.616*			
40 Yd. Obstacle Dash (sec.)	*24.4*	*.010*	*.010*			
Trunk Bend (kilograms)	*24*	*.036*	*.036*			
Jump Reach (inches)	*16.05*	*.970*	*1.940*			
		Total Wt.	*3.602*		Total Wt.	

MOTOR ABILITY CLASSIFICATION TEST—PORTION OF TABLE OF EQUIVALENTS

Change Balls			*40-yard Obstacle Dash*			*Trunk Bend*			*Jump Reach*			*Total Rank*	
Score (No.)	*Percentile*	*Weights*	*Score (Sec.)*	*Percentile*	*Weights*	*Score (Kg.)*	*Percentile*	*Weights*	*Score (Ins.)*	*Percentile*	*Weights*	*Total*	*Percentile*
24	.404	1.616	24.8	.009	.009	19	.005	.005	12.5	.595	1.190	1.788–1.854	.14
25	.519	2.076	.6	.010	.010	20	.006	.006	13.	.684	1.368	1.855–1.913	.15
26	.634	2.536	.4	.010	.010	21	.030	.030	13.5	.761	1.522	1.914–2.009	.16
27	.768	3.072	.2	.014	.014	22	.031	.031	14.	.804	1.608	2.010–2.038	.17
28	.809	3.236	.0	.018	.018	23	.032	.032	14.5	.868	1.736	2.039–2.065	.18
29	.874	3.396	23.8	.020	.020	24	.036	.036	15.	.905	1.810	2.066–2.103	.19
30	.939	3.756	.6	.026	.026	25	.040	.040	15.5	.943	1.886	2.104–2.146	.20
31	.966	3.864	.4	.032	.032	26	.097	.097	16.	.957	1.914	2.147–2.227	.21
32	.994	3.976	.2	.036	.036	27	.101	.101	16.5	.970	1.40	2.228–2.245	.22

The table of equivalents based on 476 students will be in error because of certain factors which it was impossible to eliminate the first year. One of these, the small number of students used, was of course entirely out of our control. However, other factors enter in which will gradually become inoperative as the use of the test progresses. They need mention here because they present problems which anyone else giving this test or a similar test will meet immediately. These factors are chiefly matters of standardization of method and of apparatus. For example, it was found desirable to change the type of ball in the Ball Change test, because of the high cost of the lacrosse balls used. Changing to a cheaper ball gives us one which has a different bounce, a different weight and a different surface texture which will affect the operation of the test by making the scores vary somewhat from last year's scores. Again, effectively to compare individuals it was found that in the maze run the type of shoe a girl wore sometimes had considerable to do with her ability to make speed through the obstacles, so that in order to standardize the results of this test more definitely it was found necessary to

discard shoes entirely. The element of interest caused great variations. At first, motivation was attempted only at the time of the test by means of signs urging the girl to do her best and listing the activities she could elect if she attained a certain score. As this did not prove sufficient, the following slip was put in with the material mailed from the registrar's office to each girl before she entered the University:

NOTICE TO WOMEN STUDENTS

A motor ability test will be given as a part of the physical examination. A high score in this enables the student to elect from many physical education activities the one in which she is most interested.

The student should bring to the physical examination a pair of rubber soled, canvas top athletic shoes, ankle height. These may be brought from home or purchased from the local dealers in Eugene.

Anyone attempting to use this test or a similar one should be careful to have especially designed equipment which can be used from year to year, thus insuring the elimination of what we find to be difficult and exasperating factors which need not necessarily be present.

In its present form the test is being used to classify entering students and forms the last station in the physical examination. This is given during "Freshmen Week" and therefore precedes registration. Those who should be recommended for modified or corrective work are selected by the physical examination, before the motor test is reached. All students who are physically fit for general physical education activities are then run through the test and receive a classification of "Novice" or "Regular." At the end of the freshmen year the test is repeated, and on the basis of this score a high "honor" group is selected. The novices are given special training aimed at building up the basic coordinations that they lack. The regulars have a very wide choice of activities, with the one limitation that they must take at least two terms of one activity and at least three different activities in the six terms of required work. The honor students in their sophomore year are not only given a very wide choice of activities but considerable freedom as to time and place and as much self-direction and responsibility as possible.

CHAPTER VI

General Summary

IT was the purpose of this study to set up a battery of tests which may be used to classify freshmen college women according to their motor ability. This involved the selection of elements of general motor ability, the establishment of an objective criterion,

the selection of a short battery with the highest correlations, the retesting of the battery for validity, the weighting of the separate elements and the construction of a percentile rank classification.

In order to determine the elements which contribute to this ability, judgments were secured from twenty representative physical educators in the United States. This composite judgment was used as a basis for the division of motor ability into different parts. Tests suggested by the judges were combined with others and grouped into a final classification.

Since there is no objective criterion available for college women, it was necessary to establish one. It seemed reasonable that such an objective criterion could be set up by adding together the scores made on a large number of tests measuring almost all kinds of activity. In order to reduce all scores to comparable units, a T-score table was established for each test. The T-scores were then added and a composite score established which could be used on an objective figure for comparison with various criteria to establish the validity.

The following facts seem to show that the composite score is a valid measure of general motor ability.

1. It is made up of separate elements of general motor ability set up by competent judges in the field of physical education and represents a wide range of ability.
2. The separate tests are highly reliable.
3. The separate tests have a reasonably high correlation with the composite score.
4. The scores of athletes of known motor ability on ten tests out of 14 show that their performance ranks much higher than the ordinary group.
5. Three previous studies in the field of physical tests have used a composite score on a short battery of athletic ability tests as one of the criteria for establishing the validity of tests. However, only one of these studies represents the range of ability which is contained in the composite score.
6. The composite score when correlated with the judgments of the class instructors gave a coefficient of correlation of .50 to .60 for the different classes.
7. A retest of the battery further established the reliability of the tests.
8. The composite score when correlated with the composite score of five terms of grades in physical education gave a coefficient of correlation of .62.
9. The motor ability test records of 1928-29 when correlated with those of 1929-30 gave a coefficient of correlation of .47 based on 40 cases.

10. The motor ability test records of 1929-30 when correlated with the scores on objective achievement tests given the same year gave a coefficient of correlation of .20 to .72 for the different groups.

For purposes of administration, a short battery of tests was set up. This battery consisted of those tests which had the highest self correlation, the highest correlation with the composite score and the highest correlation with the criterion. The final battery is as follows:

40-yard maze run	Trunk bend
Ball change	Jump and Reach

The judgments of instructors concerning the motor ability of the students were used as criteria against which the motor activities test was correlated to determine the relative weights or values of each test in the battery. By this method it was found that the battery given above was measuring the discrete factors which it was desirable to measure.

The raw scores on each test were changed to a percentile rank score so that it might be possible later to make comparisons between individuals on a common basis for the entire battery.

APPENDIX

MAZE RUN

Administrative Procedure:

Seven Swedish gymnasium benches are placed upon the floor in maze formation, nine feet apart. See diagram for the formation of the maze. The positions of the benches are marked on the floor with India ink, thus ensuring quick replacement for subsequent tests. The path is indicated by magnesium carbonate and red chalk arrows so as to minimize the possibility of confusion. A broad strip of adhesive tape marks the starting point. Time is taken from the sound of the whistle to the retouching of the starting tape. The girl removes her shoes and runs in bare feet.

Procedure in Giving the Test:

Operator demonstrates by walking over the path as far as first bench and explains: "Start on this piece of adhesive tape (pointing to it). One foot may be on it, but neither shall be in advance of it. Run around each bench without touching it. Follow the chalked line in the direction of the red arrows. You will finish at the same place you started. Be sure to touch the adhesive tape. Do not slow up at the finish until you have crossed the tape. Your time will be taken in seconds. The command will be: 'on your marks—get set—whistle.' If you do not follow the chalk line, return and start over again."

Equipment:

Seven benches	India ink
Chalk (red and white)	Whistle
Adhesive tape	One operator
Stop watch and pencil	

See Diagram 1, Fig. 1

JUMP REACH

Administrative Procedure:

A blackboard 3 feet by 18 inches, marked off from bottom to top in inches and half inches, is attached to the perpendicular ladder which stands out about a foot from the wall. The board is fastened so that the lower edge is five feet from the floor. A piece of adhesive was placed on the floor to the left side in line with the ladder. The student toes this mark and with both heels on the floor reaches as high as she can and makes a mark with her wet finger. From the same position she jumps as high as she can and makes another mark. The difference between these two scores is taken to the nearest half-inch for the final score.

Procedure in Giving the Test:

Operator explains and demonstrates simultaneously. "Wet your finger tips and toe the mark at the side of the ladder. With both heels on the floor reach as high as possible and make a mark. Wet your finger tips and from the same position jump as high as you can and make another mark. It is not necessary to toe the tape with both feet if you find it easier to jump with one foot back. Your score is the distance between your reach and your jump to the nearest half-inch."

Equipment:

Blackboard	Adhesive tape
Sponge and pan	Bench
Pencil	One operator

See Fig. 2

TRUNK BENDING

Administrative Procedure:

The apparatus which was constructed to test the abdominal muscles was put upon a movable platform so that it can be used in any convenient place. It occupies only about fifteen square feet of floor space and is light—see figure 3, diagram 2. The resistance scale is fastened between two straps—one to go around the girl's chest; the other to attach to the upright. The toe strap, a-b, gives the girl a better pull, the board c-d which may be moved up and down by means of pegs in the board and holes in the upright is adjustable to the student's height. Pegs in the upright e-f allow the strap to be adjusted to different heights also. The student stands at X with her back against the board c-d and her toes under the strap a-b. The operator standing at Y adjusts the brace c-d against the center of the girl's buttock, slips the strap g under the arm pits and over her chest above the breasts, buckles it so that it is comfortably taut when she is standing upright, adjusts the height of the strap h on the upright e-f so that when the girl pulls, the strap is at right angles to the pull of the abdominal muscles.

Procedure in Giving the Test:

"Step up here with your back to this board. Slip your toes under that strap, fold your arms across your chest with your fists clenched. Now, brace yourself against this board and pull forward evenly and steadily and just as hard as you can. Do not jerk. The strength of your pull is measured by this scale."

See Fig. 3, Diagram 2.

CHANGE BALLS

Administration and Directions of Test:

Two boxes, one 16 inches long, 12 inches wide and three inches high, and one 17 inches by 14 inches by 5½ inches were fastened three feet apart on a three-foot platform on a plumb with its edge. Thirty-six Eagle Brand No. 31 tennis balls were placed in the smaller box which was at the performer's left. Both left and right-handed individuals changed the balls from the left to the right. A slip of adhesive marked a spot half way between the boxes on which both palms were to be held until the whistle blew. The score was the number of balls changed into the right hand box in twenty seconds. Balls bouncing out or not reaching the box were not counted.

Procedure in Giving the Test:

"Place both palms flat on the starting mark. When I whistle, take the balls one at a time from the box on left with your left hand, place them in your right hand and then into the other box. Those balls not going in or those bouncing out do not count. Your score will be the number changed at the end of twenty seconds."

Demonstrate and explain at the same time.

Equipment:

36 Eagle Brand No. 31 tennis balls
Stop watch
Pencil
Yard stick
Hammer and nails
Two pieces of adhesive for the hands to rest on for starting line
Two boxes of above dimensions
One operator

See figure 4.

An Experiment in Physical Education Activities Related to the Teaching of Honesty and Motor Skills*

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Introduction

MUCH has been claimed for physical education activities in the past. Such activities as individual and group games and athletic contests when practiced under favorable conditions are said to be socially significant factors in the lives of the participants. Under favorable conditions such activities are said to become avenues of approach to right habits of conduct, obedience, honesty, self-sacrifice, co-operation, friendliness; and may develop qualities of leadership, and a willingness to take defeat with a smile, or victory without boasting.

Physical education has made considerable progress in developing tests and measurements so that today through physical examinations and physical tests, it can be shown whether or not an individual has improved physically because of having taken part in a program of physical activities, but little has been done to objectively measure the mental and character changes which may occur from such participation.

Physical educators believe that the transfer of the social ideals and standards of the gymnasium and playground to other phases of life depends upon the presence of identical elements in the training. In fact, some of the most important tasks of the physical educator are centered around the discovery, with the participant, of those elements which are common to physical education activities and to life in general; then to provide facilities for the youth to express himself in these activities and in an atmosphere which is both wholesome and stimulating and which affords opportunity for choice or decision by the youth himself.

The central purpose of the experiment herein described was to ascertain if such forms of behavior as honesty can be developed in a program of physical education activities, and if there would be less improvement in motor skills as a result of such participation. The equivalent groups method was used with the same instructors for both

*An abstract of an M.P.E. Thesis submitted to the School of Physical Education of the Chicago Young Men's Christian Association College, 1931.

groups. Honesty was selected as the form of behavior to be studied because there is some evidence that it can be measured objectively.

There are many important questions, the answers of which rightfully fall within the scope of this experiment, but the leading problem deals with the possibility of utilizing the behavior situations which arise in a normal physical education program, for the development of honesty.

I. Problems

Briefly stated the problems of this experiment were as follows:

(1) Can such forms of behavior as honesty be improved in a program of physical education activities?

(2) Compare the results which may accrue from participation in the following types of programs of physical education activities: (a) *Control group* — calisthenic exercises, marching, gymnastic stunts, basketball games, and informal swimming; (b) *Experimental group*—definitely planned programs of teaching the foregoing activities, and in addition, utilizing the behavior situations for character education.

(3) Which type of program stimulates the greater interest in the participating groups, as shown in voluntary attendance?

(4) Is there any correlation between attendance at physical activity classes and improvement in motor skills; between attendance and changes in frequency of deception; between socio-economic status and frequency of deception?

(5) Are controlled experiments possible or practical in the department of physical education of the Young Men's Christian Association—a voluntary organization?

(6) The sixth problem is related to the selection of tests which can be used to equate groups according to abilities, also tests which can be used to measure improvement in motor skills.

II. Method of the Experiment

Groups

The subjects of the experiment were members of a boys' gymnasium class in the department of physical education of a Chicago Young Men's Christian Association. The original group was pretested and then assigned to one of two new groups for the period of the experiment. The records of twenty boys of the experimental group and twenty-two of the control group were used in the final results.

Scoring

The raw scores of the motor ability, athletic ability, and aquatic ability tests were reduced to T-scale scores. The reason for this was that to some extent the degree of difficulty of a particular achieve-

ment as shown in the raw score could be determined.[1] It should be stated at this point that the final T-scale scores were developed from single T-scales which consisted of the pre-test and final test raw scores of the aquatic test and athletic test. The purpose was to show the following elements from one T-scale, namely, pre-test scores, final test scores, and the gain or loss. For purposes of equating the groups it was necessary to develop a T-scale from the pre-test scores.

Tests

(1) Chronological age: The purpose here was to have an equal number of eleven, twelve, and thirteen-year-old boys in each group.

(2) Intelligence: The school grade was used as a rough classification.

(3) Socio-economic status: The Taussig scale was used to show the classification of the parent of the boy as revealed by his work. This scale is made up of four grades with such professions as law and medicine in the first grade, and unskilled laborers in the fourth grade.

(4) Physical tests: Three types were used:

(a) Motor Ability: The Brace Motor Ability Test was selected as the basic test for equating the groups. It was also used for the development of Athletic and Aquatic Accomplishment Quotients, a procedure recommended by Brace as a desirable way of measuring effort.[2]

(b) Motor Achievement: Bliss's attempt to formulate a standard achievement test for boys and girls of junior high school age resulted in the selection of a wide range of events which are based on strength, speed, and skill.[3] Because of lack of equipment it was necessary to modify this test; the fence vault, one-half lever series, and the sit-up were eliminated. The events used were as follows: Fifty-yard dash, pull-up series, jump and reach, push-up series, standing broad jump, basketball speed pass, basketball goal shoot, basketball throw for distance, and baseball target throw.

(c) Aquatic Achievement: Four events, twenty-yard free style swim, twenty-yard backstroke swim, water stunts, and diving, of the Chicago Young Men's Christian Association 1000 Point Aquatic Contest were used to measure progress in aquatic skills.

(5) Tests of Honesty: Tests in honesty as exhibited in athletic contests have been developed at Columbia University by Hugh Hartshorne and Mark May for the Institute of Social and Religious Research.[4] Four elements—the dynamometer test, the spirometer test,

[1] Frank L. Oktavec, "Grading Student Achievement in Physical Education," (Ann Arbor: THE RESEARCH QUARTERLY, March, 1931), p. 99.
[2] David K. Brace, *Measuring Motor Ability,* (New York: A. S. Barnes & Co., 1927), p. 99.
[3] James G. Bliss, "A Study of Progression Based on Age, Sex, and Individual Differences," *A.P.E.R.,* Vol. 32, No. 1-2.
[4] Hugh Hartshorne and Mark May, *Studies in Deceit,* (New York: Macmillan Co., 1928).

standing broad jump, and pull-ups—make up the test. These are based on the fundamental idea that after a boy has had a certain number of trials at the events he does not improve in ability during the next few trials if taken in rapid succession. The tests are administered individually and privately; the boy is shown how to record his performance and then he demonstrates for the examiner, after which he is left alone to take additional trials, all of which he records.

Results of Pre-tests

Table I shows the arithmetical mean of both groups for all of the pre-test scores, giving some indication of the equality of the groups.

TABLE I.

TESTS	Experimental Group	Control Group
1. Chronological Age	11.8	11.8
2. School grade	6.1	6.3
3. Socio-economic status	2.4	2.5
4. Brace Motor Ability Test	45.4	43.8
5. Bliss Test	48.2	47.9
6. Aquatic Test	38.4	37.5
7. Test of Honesty (frequency of deception)	2.3	2.1

Programs

(1) Experimental group: The program related to the development of motor skills was designed to be functional rather than formal, that is, each phase of the program was used for the purpose of developing a skill or an attitude or form of behavior that should make the individual a better performer in a game, or in life. Calisthenic drills as such were eliminated and in their place drills of fundamental skills of basketball, tumbling, side horse work, and informal gymnastics were substituted. In addition to this, the relay races and games were similarly designed to further test fundamental skills. The teaching always followed a definite sequence which started the individual with the simpler movements, going progressively to the more complex.

The gymnasium class period was divided as follows: twenty minutes for drill in the fundamentals of basketball, twenty minutes for tumbling and gymnastic instruction, and ten minutes for relay races and games. Regular basketball was not played during the experiment (four months) and it is interesting to note that there was no real demand for it by the members of this class. In the swimming pool the experimenter used the same teaching technique as for the gymnasium program, basing it on the teaching procedure suggested by Burton, viz., demonstration, imitation, criticism, and drill.[5] During the swimming period which followed each gymnasium class session, instruction was given in swimming strokes, water stunts, and fancy diving.

[5] William H. Burton, *The Nature and Direction of Learning*, (New York: D. Appleton & Co., 1929).

In the program related to the development of honesty the incidental method was followed utilizing the behavior situations which arose as an opportunity to present honesty as a more desirable form of behavior than cheating. Discussion became a part of every conduct situation, the instructor raising certain questions about conduct and the boys discussing them. If a boy or team were observed cheating the instructor merely called the attention of the group to the infraction of the rules without pointing out the specific offenders, and suggested that the event be run over; but the second time nothing was said if the rule was broken. Later as other events were conducted the boys were asked if they had observed infractions of the rules, and to this query few were willing to make positive statements at the start. Gradually, however, the boys caught the idea that the activity was theirs and that they should be responsible for the action of their friends. By this process the boys quickly became aware of their own errors and the errors of others. The effort from the start was to place the responsibility upon the boy.

(2) Control group: With this group no effort was placed upon the teaching of fundamental skills in games, gymnastics, or swimming; and no emphasis was placed upon character education. The gymnasium program consisted of marching, calisthenics, gymnastics of the "follow the leader" type, and basketball games. In the swimming pool the instructor served as a "life guard" allowing for informal swimming.

III. Results and Interpretations

In Table II the mean scores for both groups for all measures used to show gain or loss are presented.

TABLE II

Tests	Pre-Test	Final Test	Mean Gain	Percentage Gain
Honesty Test				
Exp. Group	2.3	.8	1.5	65%
Con. Group	2.1	1.7	.4	19%
Brace M.A. Test				
Exp. Group	45.4	46.4	1.0	2.3%
Con. Group	43.8	44.8	1.0	2.2%
Bliss Achieve. Test				
Exp. Group	48.2	53.7	5.5	11.7%
Con. Group	47.9	50.3	2.4	5.1%
Aquatic Test				
Exp. Group	38.4	50.6	12.2	32.0%
Con. Group	37.6	42.1	4.6	11.0%
Athletic A. Q.				
Exp. Group	108.0	117.0	9.0	8.3%
Con. Group	108.0	111.0	3.0	2.7%
Aquatic A. Q.				
Exp. Group	82.9	110.0	27.1	32.0%
Con. Group	89.3	94.6	5.3	5.9%

Attendance Percentage. Exp. Group 55%. Con. Group 40%.

The foregoing table shows that the experimental group made a greater gain than the control group in every ability measured. The ratios were as follows:

(1) Gain in honesty (i.e. decrease in deception score), three to one.

(2) Athletic-gymnastic ability (Bliss test), two to one.

(3) Aquatic ability, three to one.

(4) Percentage of attendance was higher for the experimental group, the ratio being five to four.

(5) Improvement in the scores of the Brace Motor Ability Test was about the same for both groups.

(6) The Athletic and Aquatic Accomplishment Quotients serve to cross check the results of the Bliss and Aquatic tests.

Table III shows the extent of correlation between the various measures.

TABLE III

	Variables	r.	p.e.*
1.	Attendance and athletic improvement (Con. group)	.63	.08
2.	Attendance and athletic improvement (Exp. group)	.09	.14
3.	Attendance and aquatic improvement (Con. group)	.61	.09
4.	Attendance and aquatic improvement (Exp. group)	.03	.15
5.	Frequency of deception and athletic scores (Both groups)	—.14	.08
6.	Frequency of deception and aquatic scores (Both groups)	—.10	.10
7.	Frequency of deception and socio-economic status (Both groups)	—.22	.09
8.	Frequency of deception and attendance (Both groups)	—.02	.15
9.	Athletic scores and motor ability (Both groups)	.42	.08
10.	Aquatic scores and motor ability (Both groups)	.49	.08
11.	Aquatic scores and athletic scores (Both groups)	.30	.09

The athletic scores are from the Bliss test; Motor Ability scores from the Brace Motor Ability Test.

Two conclusions are drawn from this table:

(1) The coefficient of correlation between frequency of deception and socio-economic status suggests that boys from the lower socio-economic levels were more deceptive than those from the higher levels; and that boys of lesser athletic ability and aquatic ability tend to be more deceptive.

(2) Attendance may be assumed to be an important factor in programs where no teaching is attempted. This assumption is based upon the first four coefficients of correlation in Table III. No case was considered in these findings whose attendance was below twenty of the fifty-five sessions of the class.

The number of cases, forty-two, is much too small upon which to base positive conclusions, but in so far as the results are valid they point in the direction of the following assumptions which are presented in the same order as listed in the problems.

*The probable error is plus or minus.

I. Findings in behavior.

(a) The form of behavior called honesty can be influenced in a program of physical education activities over a period of three months.

(b) Definite attempts to develop honest behavior seem to be about three times as effective as where dependence is placed on honesty as a by-product of an activity.

(c) Skills are not sacrificed when a definite attempt is made to develop honest behavior.

II. Findings in development of motor skills.

(a) Skills in gymnastics, athletics, and aquatics can be increased during a three months period, and in measurable amounts.

(b) Definitely planned teaching is much more effective in developing skills than mere practice of the activity without instruction. The ratio is between two and three to one.

III. A program of the type described for the experimental group seems to stimulate greater interest, this being measured by a greater percentage of voluntary attendance.

IV. Attendance seems to be a more important factor in programs of physical activities where no attempt is made to teach than where teaching is definitely planned. It is obvious that attendance is necessary in either case but it would seem that attendance alone does not account for the greater improvement of the experimental group.

V. Controlled experiments are possible in the Young Men's Christian Association but certain factors such as irregularity of attendance, also the fact that it is a voluntary organization, constitute difficulties that are absent in other institutions such as the public schools where attendance is compulsory.

VI. The Brace Motor Ability Test classified the boys of the age group for this experiment on the basis of motor ability as adequately as the whole battery of physical tests. However, such other tests as were used are necessary in order to show achievement.

Physical Skill Tests for Sectioning Classes Into Homogeneous Units

By GRANVILLE B. JOHNSON
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IN THE last twenty years there have been produced an astonishing number of physical skill tests. Cozens[1] has reported "some sixty odd tests." Their general purpose is to determine the "neuro-muscular status" of an individual, for purposes chiefly of adapting the physical and athletic program to differences of ability. The methods of these tests have swung away from anthropometrical measurements toward the measurement of muscular skills. Some are prognostic; some are for the immediate placement of the subjects; some are achievement tests; but all of them have to do with performances of particular skills. They are made up of athletic and gymnastic exercises of the more common and elementary sorts. They do not measure skill in general, but rather specific skills. It is true, some of them, such as Cozens' tests, attempt to determine a composite index of a person's skill or his "neuro-muscular status" by providing a great variety of exercises of different types.

The common difficulty, however, with physical, athletic, and gymnastic tests, although they do concern skill, is that they admit too many uncontrolled items in the scoring. Tests of any sort involving strength or endurance put a premium on size, which is not an essential element of physical skill. Athletic exercises, such as the simpler elements of common sports and games, give results which, to be valid, must be corrected for the experience of the subjects in those activities. Such corrections are very difficult. Gymnastic tests usually involve a certain degree of unfamiliarity, strangeness, and also fear, as well as certain requisites of strength. All these extraneous elements invalidate any test of purely neuro-muscular skill. They may demonstrate the "status" of an individual in regard to native ability and practice in certain special skills, but they do not indicate his native neuro-muscular endowment or his potential skill.

We offer a new physical skill test which, we believe, eliminates all these elements which invalidate ordinary skill tests. This test of physical skill is an attempt to test native neuro-muscular skill capacity. Its purpose is the placement of students into homogeneous groups for purposes of better adapting the physical program to their differences.[2]

1 Bovard and Cozens, *Tests and Measurements in Physical Education.*

2 This test, the result of over ten years of application, yields a very satisfactory correlation with the Brace and the Rogers' tests, and is valuable for sectioning students into teaching units compatible with their capacity.

It has been found that it is native skill, and not their present level of achievement, which determines the rate at which they can advance in a physical education program. It has been demonstrated also at the University of Denver that in gymnastic tests, a student's performance on the mats is a very reliable indication of his performance on all the apparatus and sports together. This is probably due to the fact that the mats are less strange than other apparatus or sport situations and they require all the fundamental body skills. The evolution of our skill test was the elimination of all exercises which involved any pronounced elements of strength, speed, endurance, fear, familiarity, strangeness or practice. Out of a hundred exercises, ten were selected. These exercises are natural and familiar in so far as they have to do with no apparatus except the body and as they involve some type of locomotion. In the main they are unusual enough to avoid much possibility of the subjects having practiced them. Then, too, they require no speed or endurance, and only the amount of strength necessary and normal in common manners of locomotion.

This test for determining native differences in physical skill is a group of exercises involving various methods of locomotion for a distance of fifteen feet. As has been suggested, these exercises do not involve strength, speed, or endurance because these elements of skill are the product of experience and environmental conditions and are therefore acquired, not native. Moreover, the exercises are foreign to any sort of natural activity, thus avoiding the possibility of the subjects having practiced similar activities. The subjects are given an oral explanation and an expert demonstration of each exercise before the members of the class attempt it. Thus they have a clear mental picture of the exercise and the problem is simply one of securing the necessary neuro-muscular coordination to perform it. The last in line has no advantage over the first because the mental picture secured from the demonstration is not improved by watching other students perform. We are testing, it is believed, native neuro-muscular coordination and nothing else.

The test is easily administered and can be given to twenty or thirty persons in the usual forty-minute gymnasium period. This test has a reliability coefficient of .97 and a validity coefficient of .69. Hence it is an adequate basis for dividing a class into sections or groups of equal ability. The only equipment needed is a sheet of ten ounce canvas about eight feet wide and twenty feet long, marked as shown in the accompanying diagram, gymnasium mats, and a scoring sheet. This canvas is laid over two standard 6x10 gymnasium mats placed end to end, and the edges are tucked under or fastened down to keep the surface smooth.

The students may be lined up along one side of the chart where they can clearly see. The scorer may sit on the opposite side where

he, too, can see every line. The scoring is objective, and is decided chiefly by whether or not the subject's feet touch the canvas at the proper places and within the specified boundaries.

The pattern, which is painted on the canvas, is a rectangle four and one-half feet wide and fifteen feet long, divided into squares eighteen inches on a side (see chart). This makes three lanes eighteen inches wide down the length of the chart. The main outline of the rectangle and the lines marking the lanes are painted in black lines three-fourths of an inch wide. The second, fourth, and alternate squares in the two outside lanes are painted solid black. The squares in the center lane are not marked off as squares, but the first, third, and alternate spaces in this lane contain each a target twelve inches by three inches in the center of the square. There is an additional target placed outside the main pattern on the finish side. There is another lane two feet wide marked in red down the center of the canvas, divided half way by a cross line of red; this is used only in the rolling exercises.

The instructor should explain the purpose and the general nature of the test, and point out the markings on the chart, disregarding the red markings until they are needed. He should also explain the method of scoring so that the subjects may observe and score each other. To explain this he simply demonstrates the errors on which the scoring is based: e.g., position, overstepping the bounds, lack of rhythm, etc. The mental picture of each exercise is presented through both eye and ear, the instructor giving explicit directions for each exercise and demonstrating it. The instructor must be completely familiar with the execution of the ten exercises; he must be able to give a perfect performance. He must also master the technique of giving the instructions. Each exercise is demonstrated only once, and the pupils must all perform it before the next exercise is introduced. The subjects must not imitate their classmates; they imitate only the instructor. The exercises are as follows:

1. Straddle Jump.

Hands on hips. Start with feet together in first center target. Jump astraddle to first two black squares. Return to feet-together position on second target. Proceed thus across mat in regular jumps, finishing on the finish target.

2. Stagger Skip.

Hands on hips. Start with feet together in front of the right lane. Step with left foot on first center target and hop, still on left foot, to first black square on left. Step with right foot to second center target and hop, still on right foot, to second black square on right. Continue in regular skips across mat.

3. Stagger Jump.

Hands on hips. Feet together throughout the exercise. Start with feet together in front of right lane. Jump obliquely with both feet to first white square on left, then obliquely with both feet to first black square on right, then to second white square on left, finishing on finish target.

4. Forward skip, holding opposite foot from behind.

Start with feet together before either right or left lane (optional). Step with right foot into first white space, raising left foot behind and taking it with right hand behind right thigh. Hop in this position on right foot to first black space. Release left foot, step with left foot to second white space, lifting right foot behind and taking it with left hand behind left thigh. Hop in this position on left foot to second black space. Continue thus across the mat.

5. Front Roll.

Disregard all black markings and perform in the red lane. Start outside of chart in front of center lane. Perform two front rolls, the first within the limits of the first half of the lane, the second within the limits of the second half, never touching or over-reaching the red lanes.

6. Jumping Half-turns, right or left.

Start with feet together on first target and hands free. Jump, feet together, to second target while executing a half-turn right or left, ending on second target facing starting end. Jump to third target, executing another half-turn, rotating in same direction (as a barrel would be rolled along upright) ending on the third target facing the finish. Continue across mat, ending on finish target facing starting end.

7. Back Roll.

Perform in red lane. Start in front of red lane with back to the pattern. Execute two back rolls, one on each half of the lane.

8. Jumping Half-turns, right and left alternately.

Start as in (6) on first target. Jump with both feet, as in (6) to second target executing a half-turn either right or left. Jump, as in (6), to third target executing half-turn *in the opposite direction.* Continue across mat, alternating the direction of rotation, finishing as in (6).

9. Front and Back Roll Combination.

Perform in red lane. Start as in (5), facing red lane. Perform a front roll in the first half of the lane, finishing with legs crossed at ankles and executing a two-feet pivot turn right or left. Perform a back roll in the second half of the lane.

10. Jumping Full Turns.

Start outside of chart in front of first white space in either outside lane. Jump with feet together to first black space in same lane, executing a *full turn* with the body right or left. Continue across the mat, executing full turns, rotating in the same direction, being sure to land on both feet in the black spaces.

Scoring

Maximum score 100; 10 for each exercise. Minimum score, 0, for any exercise.

When a step, skip, or jump is made into any white or black square with one or both feet, feet must land entirely within the limits of that square. When a step, skip, or jump is made on to any target with one or both feet, feet must land touching the target, and not touching side lines or outside lanes. In the rolls, the subject must not touch or over-reach the side-lines of the red lane and must complete each roll within the prescribed half of the lane, not over-reaching the end markings. All the exercises must be performed with a reasonably erect and dignified posture: the position in the first three exercises is "hands on hips." In any exercise the prescribed position must be observed throughout the exercise. The jumps must be performed with a regular rhythm, about two (short) jumps to the second or five seconds for each exercise.

1. Deduct one from the maximum score for each jump in which feet over-step squares or miss target, one for each jump in which feet do not land at the same time, one if position is discontinued somewhere in the exercise, and one if rhythm is not maintained. (If a subject completes a jump with heels over-stepping a square, but lifted so as not to touch the canvas, the jump is good.)
2. Score as in 1, except that feet do not come down together.
3. Score as in 1.
4. Deduct one for each step or jump in which subject over-steps a square, or in which he does not have the proper position, or both. Deduct one for lack of rhythm.
5. Count five for each roll. Deduct two for over-reaching red line right or left in each roll. Deduct one for over-reaching end limit on each roll. For failure to perform a true roll, deduct five.
6. Five jumps. Deduct two for each jump in which the subject does not land with both feet on the target, or turns the wrong way, or both.
7. Score as in 5.
8. Score as in 6.
9. Score as in 5. Deduct one also if subject over-steps end border or executes turn wrong.
10. Score as in 6; deduct two if subject fails to land on both

feet, or over-steps black square, or turns too far or not far enough, or loses balance before starting next jump.

The total points deducted, subtracted from the maximum of 100 gives the subject's score on the physical skill test.

Sections can be made according to scores, using five or any other number of divisions. For five sections, the divisions can be based on the natural curve of distribution. In each of the extreme divisions will be the same number of cases, and in each of the next extreme divisions the same number, according to the several systems in common use, as follows:

Section 1	8%
Section 2	24%
Section 3	36%
Section 4	24%
Section 5	8%

or the total range of scores of the group tested, from the lowest to the highest can be divided into five equal parts, to secure the range of the five sections. The first method allows a sectioning on the basis of the average ability of the group; the second permits a natural skewing of the curve to fit the peculiar distribution of the group. The middle group, in large and normal classes, will always be the largest.

This test has been given to 1,500 pupils of both sexes and ages ranging from 11 to 38 years. Physical size did not appreciably affect the functioning of the test. That is, a child of twelve years had no more difficulty in executing the exercises than did the college freshman. The curves of distribution of ability of both extreme age groups have the same characteristics. However, the correlation between intelligence scores and the physical test scores is markedly different for the two groups. For those on college students, a correlation of .49 was found, while for junior high pupils, it was only .13. We cannot account for this at the present time, except that it is likely a manifestation of maturation.

This test for sectioning must not be considered the last word in measurement of physical differences, but with intelligent use it is extremely valuable, especially in sectioning large classes in physical education. It is hoped that this presentation of the test will be useful to teachers, and that it will stimulate further research in the matter of differences in physical skill. As the test stands now, we can say of it that:

1. Within broad limits, it measures native physical skill.
2. With matured groups its results have a relatively high correlation (.49) with the results of intelligence tests.
3. It makes easy and valid the sectioning of classes into homogeneous groups.

Following are charts of the movements in the ten exercises:

EXERCISE I

STRADDLE JUMP

Finish

Start

EXERCISE II

STAGGER SKIPS

Finish

Start

EXERCISE III

STAGGER JUMP

Finish

Start

EXERCISE IV

FORWARD SKIP, HOLDING OPPOSITE FOOT FROM BEHIND

Finish

Start

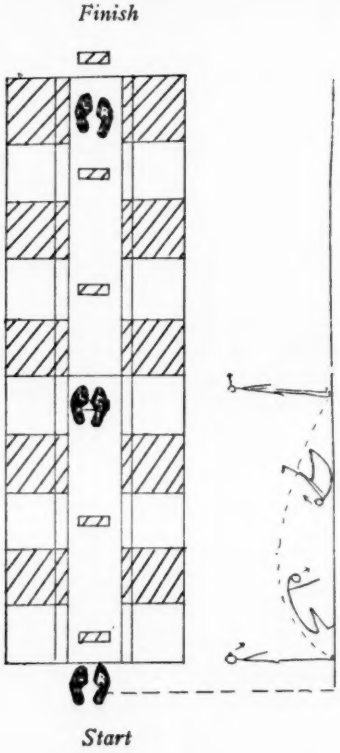
EXERCISE V

EXERCISE VI

EXERCISE VII

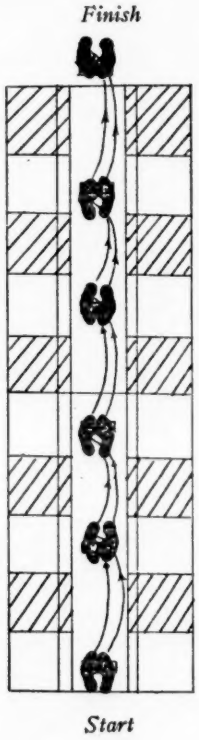
EXERCISE V

Forward Rolls



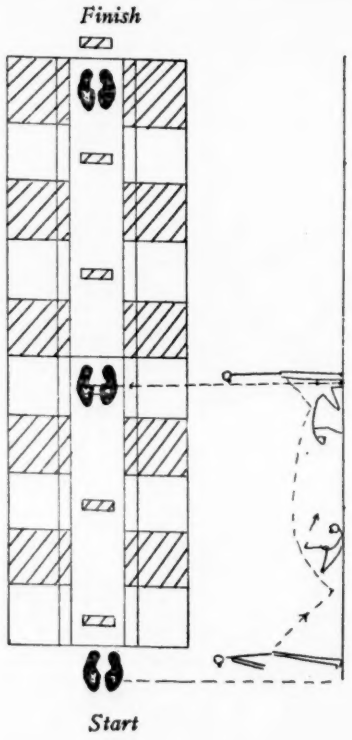
EXERCISE VI

Half Turns Right or Left



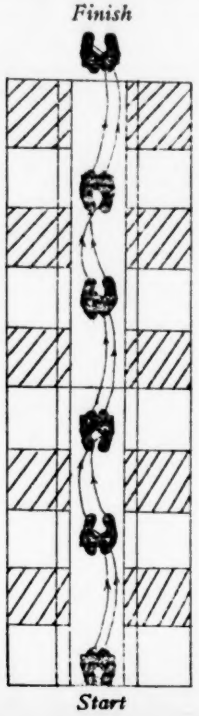
EXERCISE VII

Backward Rolls



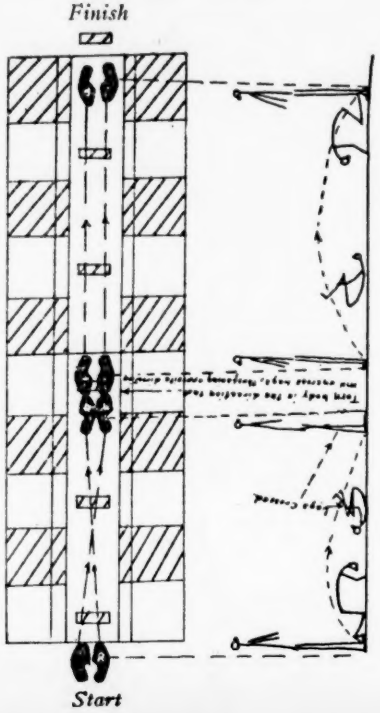
EXERCISE VIII

HALF TURNS RIGHT AND LEFT, ALTERNATE



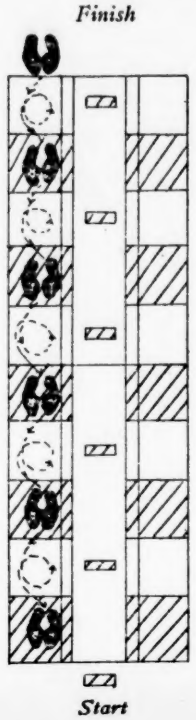
EXERCISE IX

FRONT AND BACK ROLL COMBINATION



EXERCISE X

FULL TURNS JUMPING



The Periodic Fluctuation in Physical Efficiency During the Menstrual Cycle

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IT HAS long been taken for granted that the menstrual function reduces woman's efficiency and ability to carry on her normal activities. This opinion is the popular one of today. It can be traced back very largely to primitive folklore and practices in regard to the matter. Even today one may meet with beliefs no less primitive and unfounded.

During recent years investigations have been made to determine whether or not there is any scientific basis for the belief that menstruation is a determining factor in woman's activity. The earlier ones seemed to verify it. More recent studies, however, have shown varying results.

There has also been a growing interest in the testing of physical efficiency, particularly from the economic standpoint and from the point of view of the effect on athletic ability. This interest has been centered chiefly on men. However, since women are becoming more and more involved in both business and athletics there has been considerable concern as to whether their efficiency may be expected to remain as stable as that of men or whether it shows periodic fluctuations.

The purpose of this investigation is to determine whether or not there is a rhythmical variation in physical efficiency from period to period in the menstrual cycle.

A review of the literature will show what has been accomplished along this line up to the present time.

Review of Literature

One of the factors which promoted a study of this problem was the entrance of women into the universities. The discussion centered chiefly around the physiological handicap which women were supposed to possess.

The first publication on the subject was by Jacobi (1)* in 1876.

*Numbers in parentheses refer to Bibliography at end of article.

Basing her opinion on observations of temperature, pulse, and excretion of urea, she stated that efficiency showed a definite rhythm, rising and falling in relation to the menstrual period, but that it was not such as to indicate necessity for rest in normal cases. She further stated that she saw nothing in university education that might endanger the health of women. However, her investigations were on women only, and the thought did not seem to arise that one could not, therefore, say conclusively that such variations were peculiar to women.

In 1890, Van Ott's (2) conclusions were based on tests on a varying number of persons on caloric radiation, muscular energy, vital capacity, and reaction time of the knee reflex. He summarized his results as follows: "The energy of functions of the female organism is augmented before the beginning of menstruation and diminished immediately before or with the onset of the hemorrhage."

About ten years later Mosher (3) published the results of her investigation which were both clinical and experimental. She based her conclusions very largely on daily blood pressure tests on both men and women. She found: *1*) a rhythmic fall of blood pressure at definite intervals occurred in both men and women; *2*) the fall in women occurred near or at the menstrual period, but was gradual and within definite limits; *3*) the curves were not peculiar to either sex and were apparently indistinguishable. This is apparently the first attempt to compare results with the two sexes and to determine whether or not such variations as exist were to be found only in women.

Cullis (4) made a study of pulse frequency over a period of several months and found that it was always lowest during the menstrual period, there was a rapid post-menstrual rise and the rest period was about the same or a little higher than that of the pre-menstrual.

Amos (5) made daily tests on blood pressure with respect to the menstrual cycle and found that there was a rise a day or two preceding menstruation, a decided fall at the beginning of menstruation with a gradual rise up to a few days after menstruation ceased.

In 1914, Hollingworth (6) published the results of a very extensive experiment conducted to determine the effect of the menstrual cycle on motor performance, fatigue, steadiness, perception, typing, and physiological processes. Her conclusions were: *1)* careful and exact measurement does not reveal a periodic mental or motor inefficiency in normal women; *2*) no part of the period is affected; *3*) variability is not affected by physiological periodicity; *4*) no regularly recurring period of maximum efficiency within each month is discernible, and *5*) no agreement is established between curves plotted for pulse, blood pressure, temperature, caloric radiation, etc., and the curves of work for mental and motor traits here tested.

The same year King (7) published the results of a long experiment to determine whether the periodic rhythm in blood pressure is

altered if regular exercise is taken during the menstrual phase as well as other phases of the cycle. She found that pulse and temperature showed a rhythmic movement reaching the maximum a few days before menstruation and the minimum a few days after. Blood pressure failed to show any such rhythm. She concluded from her findings that there had been an over-emphasis on the inefficiency of women during the menstrual period.

Moore and Cooper (8) made a study of blood pressure, pulse rate, and respiratory rate. The pulse rate times blood pressure was used as the circulatory index. The cardio-vascular and respiratory curves showed rhythm similar to those of muscular efficiency, thus helping to improve the reliability of each. The low menstrual records were no lower than chance variations and hence would not indicate extensive general lowering.

Moore and Barker (9) by daily measuring of muscle resistance found a definite monthly rhythm with a slight menstrual fall but more significant pre-menstrual and post-menstrual increases. The menstrual fall was not considered sufficient, however, to indicate a depression great enough to interfere with women's activities.

Howell (10) states that there is a slight lowering of general efficiency just preceding menstruation, that body temperature and pulse rate show a regular wave, reaching the maximum just before, and minimum slightly after menstruation. These changes are too slight to affect general metabolism and do nothing more than influence the general feeling of well-being.

Truesdall (11) compared the pulse and blood pressure, and return to normal after five minutes rest, standing two minutes and after exercise which consisted of climbing on a chair five times. This test of circulatory efficiency showed a somewhat higher rating during the menstrual period and was lower between periods. The total average swing, however, was very small.

Griffith (12) and his co-workers found by working with both men and women that women on the whole show no greater variability in pulse rate and blood pressure than men. The variability from subject to subject showed little agreement in details except for a slight increase in pulse rate in the late inter-menstrual stage.

Grollman (13) conducted an experiment in which he attempted to eliminate all other factors which might affect the individual. His scheme was to make the tests immediately on the subject's awakening in the morning. His conclusion is that minor variations do occur in the physiological functions as a result of menstruation and that more decided changes are due to other factors and experimental errors. His work being based on a single subject cannot, however, carry much weight.

Dűntzer (14) gathered evidence from 1,561 women competing in

the Cologne Gymnastic Festival in 1928. These tests were not measures of endurance but of momentary efficiency, that is, whether or not their records in events such as jumps or javelin throws were equal to what they usually made. Achievement in 60 per cent of the cases was as great or greater during the menstrual period and lower in only 40 per cent.

A study of 110 women students of physical education was made by Dűntzer (15) with regard to the effect of exercise on their menstrual health and their performance records. Only 42.5 per cent of the subjects were less efficient during the menstrual period and this was mostly because they did not care to exert themselves. The same performance was shown by 51 per cent and better performance by 6.5 per cent. Shortly before the period 24 per cent of the subjects had less energy than usual and among these there were some who showed no loss of efficiency during the period itself; 75 per cent showed the same performance and 1 per cent did better. Shortly after the period 94.6 per cent showed the same, 1.8 per cent were better, and only 3.0 per cent less ability. Both groups studied expressed a decided sensitiveness to extreme heat and cold which indicated that care should be taken under such conditions. This study as well as the other by Dűntzer confirms the opinion that those who are accustomed to exercise may continue (except in swimming and endurance contests) provided they do not exert themselves more than normally.

Bilhuber (16) also studied the effect on performance in sports, testing accuracy, speed, and endurance. The subjects included both men and women. She found *1)* that motor ability was not effected by the menstrual cycle, *2)* that there were no periodic fluctuations or peaks, and *3)* that fluctuations during menstruation were no greater than those ocurring at other times or with men.

Wiltshire (17) made a study of basal metabolism with reference to the menstrual cycle, and included a standard exercise and return to normal following it. She found that the cost of work and recovery are the same during the menstrual period and inter-menstrual period.

More recently Frey (18) studied the efficiency of college women from various standpoints by use of the pulse-ratio test. She found *1)* the normal heart rate during the menstrual cycle was relatively constant; *2)* the individual is most efficient during the pre-menstrual and menstrual periods, less efficient during the post-menstrual, with a rise during the rest period.

Such variations in the results of various investigators, as have just been indicated, seem to call for further study in this field.

Technique

Due to the success attained by other investigators in rating physical efficiency by the use of the pulse-ratio test, it was employed for this purpose in the study reported here.

The technique used in this investigation was essentially the same as that employed in the investigations made by Hambly (19), Hunt (20), Tuttle and Skien (21), Wells (22), Tuttle and Frey (18), on problems concerning physical efficiency. The index to the physical efficiency is the pulse ratio[1] which is represented by the ratio of the resting pulse rate to the rate after exercise. This ratio is found by dividing the total pulse for two minutes after a known amount of exercise by the normal resting pulse for one minute. The exercise consisted of stepping on and off a stool, 13 inches in height, the intensity of the exercise being determined by the number of steps per minute. Light exercise consisted of 15 steps and the more strenuous exercise of 30 steps.

The ratio for light exercise is slightly above two and for the heavy exercise it is distinctly higher. For the purpose of comparison some ratio common to all must be adopted. The ratio 2.5 was selected as the most convenient one to use in this case.[2] Having determined the two ratios following exercise, the number of steps required for a 2.5 ratio is calculated by use of the following formula suggested by Tuttle and Wells (24):

$$e = \frac{e_2 - e_1}{r_2 - r_1} (r - r_1) + e_1 \quad \text{where}$$

e = any desired exercise; e_1 the light exercise; e_2 the more intense exercise; r_1 the ratio corresponding to e_1; r_2 the ratio corresponding to e_2; and r the ratio corresponding to e (in this case 2.5).

Any number of steps may be chosen to represent 100 per cent efficiency. For these subjects it was placed at 50, that is, an individual who required 50 steps per minute to produce a ratio of 2.5 is considered 100 per cent efficient. The actual percentage in each case is calculated as follows:

$$\text{Per cent efficiency} = \frac{(\text{number of steps required for 2.5 ratio})\ 100}{50}$$

The menstrual cycle was divided into the four stages as given by Howell (10) and one test given in each. The inter-menstrual period is considered in its three phases according to the physiological changes

1 The use of the pulse-ratio test for rating physical efficiency has been described in detail by Tuttle (23).

2 In order to determine some common ratio for comparing the subjects investigated it is much more convenient to resort to mathematical calculation. In order to do this, two exercises and their resulting ratios are required. The validity of this calculation has been proven by Tuttle and Wells (24).

occurring in the uterus. The post-menstrual period is about seven days in length and is a period of rapid regeneration following menstruation. The next twelve days constitute a period of rest in which the uterus is in a quiescent state. The pre-menstrual period of about five days is characterized by congestion, dilation of the capillaries and glands and thickening of the endometrium. The menstrual period is considered as the time of flow, lasting about four days.

The dates set for the test were calculated to come about the middle of each stage and were as follows: Three days preceding the flow, second day of flow, three days following cessation of flow, and twelve days following cessation of flow. Because of the fact that it was not always possible to get the subject at the exact time, the tests varied slightly from this schedule. This was particularly true of the pre-menstrual tests because of the difficulty in estimating when menstruation would begin. All tests, however, fell within the length of time in the above classification. Those on each individual were taken within a single month, beginning with the pre-menstrual period. All four tests were given as nearly the same time of day as possible. Strenuous activity and loss of sleep preceding the tests were avoided.

Data

Data were collected from 100 women between the ages of 16 and 41 years. All the subjects experienced normal menstruation, that is, there was no history of dysmenorrhea in any case. However, when the data were evaluated it was found that 22 cases had to be discarded due to incompleteness and obvious experimental errors. The means for the remaining 78 cases are presented in Table 1.

TABLE I

Phase	Pulse rate	Efficiency rating
Pre-menstrual	84.21 ± .86	51.22 ± 1.22
Menstrual	81.60 ± .72	50.12 ± 1.04
Post-menstrual	83.20 ± .93	53.60 ± 1.30
Rest	85.23 ± .97	54.10 ± 1.27

The Significance of the Data

The significance of the differences between the pulse rates of the different phases of the menstrual cycle is shown by the following calculations:

Phase			Observed Difference	Observed Difference / P.E.diff.	Chances of a true Difference
Pre-menstrual	*vs.*	menstrual	2.61 ± 1.12	2.33	95
		post-menstrual	1.01 ± 1.26		
		rest	1.02 ± 1.29		
Menstrual	*vs.*	post-menstrual	1.60 ± 1.17	1.45	84
		rest	3.63 ± 1.20	3.02	98
Post-menstrual	*vs.*	rest	2.03 ± 1.34	1.51	85

The significance of the differences in efficiency ratings for the different phases of the menstrual cycle is shown by the following calculations:

Phase			Observed Difference	Observed Difference / P.E.diff.	Chances of a true Difference
Pre-menstrual	*vs.*	menstrual	1.10 ± 1.58		
		post-menstrual	2.38 ± 1.70	1.40	83
		rest	2.88 ± 1.73	1.66	87
Menstrual	*vs.*	post-menstrual	3.48 ± 1.66	2.09	92
		rest	3.98 ± 1.64	2.42	95
Post-menstrual	*vs.*	rest	0.50 ± 1.78		

Discussion

An examination of the data indicates that the pulse rate is highest during the rest period and lowest during the menstrual phase, there being 98 chances in 100 that the difference is a true one. Furthermore, statistical treatment of the data shows that there is a good chance that there is a difference between the pulse rate during the menstrual and pre-menstrual phases of the menstrual cycle. When the other phases are compared, the differences, although some of them are better than fifty-fifty, are not particularly significant.

A statistical consideration of the data relative to the physical efficiency ratings indicates that they are somewhat of the same order as in case of the pulse rate. The efficiency rating is highest during rest and lowest during the flow, there being 95 chances in a hundred that the difference is a true one. Furthermore it is indicated that there is a good chance that there is a true difference between the menstrual and the post-menstrual efficiencies. A comparison of the other phases shows that although the differences between some of them is better than a guess, they are not particularly significant.

On the basis of means and their significance, one might be misled in interpreting the results of this investigation. In the first place it must be remembered that in no case is the observed difference four times its probable error. One must not fail to consider the fact that since the pulse rate is the basis for comparison, errors in counting might account for part of the difference, although the chances are that the errors would fall approximately equal on both sides.

Another point to be considered in interpreting these data is that the variations from period to period are an individual matter. A distribution of the data shows that 18 cases were most efficient in the pre-menstrual phase, 18 in the menstrual, 20 in the post-menstrual, and 20 during rest. There were two subjects who had the same rating during the post-menstrual and the rest phases. The phase of lowest efficiency for 19 of the cases was the pre-menstrual, for 21, the menstrual, for 19 the post-menstrual, and for 15 the rest phase. Four had an equal rating for two periods. Since there is no general

tendency toward a high or low period for the group when considered from the standpoint of distribution it is reasonable to suppose that the mean differences are due to causes other than menstruation.

Conclusions

On the basis of the data previously presented, the following conclusions seem to be justified:

1) menstruation does not bring about a cyclic rise and fall in physical efficiency;

2) the pulse rate does not show any significant fluctuations with respect to menstruation;

3) the variations which occur from time to time during the menstrual cycle are the result of factors other than menstruation.

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A Study of the Effects of Inter-Collegiate Swimming on the Sinuses

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MANY former college swimmers have been troubled with sinus infection. Some have wondered if swimming during their college course had any effect on their sinuses. Coaches, swimmers, and others closely associated with competitive swimming have suspected for some time that there may be some connection between the two. Many questions have been raised relative to the effect of inter-collegiate swimming on the sinuses.

1. Does swimming affect the sinus cavities?
2. What events in swimming affect them the most?
3. Is a chronic sinusitis increased by swimming activity?
4. Does the method of exhalation during swimming have any bearing on the question?
5. How does this activity affect the ears?
6. What sinuses are most affected?
7. Is the common cold contracted in the swimming pool room related to the sinusitis found in swimmers?

Many other questions could be asked regarding this subject but the foregoing are enough to stimulate thought.

A study has recently been completed by the author in an attempt to try to answer some of the above questions.

In an attempt to get historical data on the subject, literature as far back as 1910 was perused. It was found that there is very little literature that deals with the subject of swimming and sinuses and there is none, as far as the author can find, that deals with inter-collegiate swimming and the sinuses.

Ralph A. Fenton, of Portland, Oregon, F. E. Hasty, Nashville, Tennessee, and H. Marshall Taylor, Jacksonville, Florida, have done some fine work in researches relative to swimming and its effect upon the sinuses.

It is apparent in a problem of this nature that there are several causative factors which may individually or collectively contribute to sinusitis as a result of swimming. These are numerated below:

1. Man's lack of adaptability to aquatic life.
2. Upright position of man prevents gravity drainage of the Maxillary and Sphenoidal sinuses.
3. Contaminated swimming water.
4. Modern swimmers submerge head.

5. Lowered body resistance.
6. Incorrect breathing habits during swimming.

It can be readily seen that each of the foregoing will have a tendency to affect the sinuses in a lesser or greater degree. Climatical conditions may also have some effect but as no definite check could be made this was not considered.

1. H. Marshall Taylor[1] has shown the modifications the aquatic animals have for their environment and the striking absence of such adaption in man. He notes the means with which nature has endowed the aquatic animals for preventing water from gaining entrance to the respiratory tract; the means they have for maintaining their body temperature in cold water and the absence of these provisions in man. He says—man is essentially a terrestrial being, and his anatomy and physiology are not modified for a water environment.

2. In assuming an upright position man lost the gravity drainage of his Maxillary and Sphenoidal Sinuses, which means that the drainage of these sinuses is wholly dependent upon wave-like cilia of his ciliated epithelium. Hence the drainage of the sinuses of man is not as complete as it is in the aquatic animals, in whom the astia are so situated that gravity drainage is a material fact.

3. According to F. E. Hasty[2] some rhinologists feel that the infections in the upper respiratory tract resulting from swimming are due primarily and directly to the bacteria of the water getting into the nose and paranasal chambers.

Taylor[3] says that sinus infections secondary to swimming evidently come from one or both the following sources: either foreign bacteria may gain entrance to the deeper portion of the nasal apparatus and conjoined structures; or bacteria normally and constantly present in these regions may be allowed by a lowered resistance on the part of the individual to multiply to pathological proportions.

4. In swimming strokes of past years such as the side stroke and non-racing breast, the head was very seldom submerged. Consequently very little water found its way into the nasal passages. Because of this fact breathing was never looked upon as a problem.

In the last decade or so, since the advent of the different racing strokes, the face is submerged most of the time. It is natural to assume that in this style of swimming there will be some water that will find its way into the nasal passages and consequently into the sinuses. Because of this fact breathing has become a great factor in the proper execution of the more modern strokes.

5. Researches show lowering of body temperature half a degree per hour when children were standing around in wet bathing suits.

1 H. Marshall Taylor, "Sinusitis and Swimming." *American Laryngolical Association Magazine* 47: 3, p. 99, March, 1925.
2 F. E. Hasty, "Paranasal Sinus Infection and Swimming," *J.A.M.A.* 89:9, p. 507 S. 1927.
3 Taylor, *op. cit.*, p. 99.

The question of the duration of time one can remain in the water without reducing the body temperature and lowering one's resistance is a matter of paramount importance. We know that cold water has a veritable appetite for heat, and all authorities agree that prolonged cold baths cause a rapid loss of body heat. It may be that during this period of lowered body resistance that the bacteria that are normally and constantly present in the sinuses may be allowed to multiply to pathological proportions.

6. Because the five pairs of sinuses (Frontal, Ethmodial, Sphenoidal, Maxillary, and Mastoid) have direct communication with the respiratory tract and indirect communication with each other it can be readily seen that breathing and air pressure in the head can very readily affect them.

The air in the accessory sinuses is exposed to constant movement, and proper ventilation normally results. Should this ventilation be interrupted, serious consequences may result.

Method of Collecting Data

In collecting data for this study the author gained many valuable facts and suggestions from the following individuals: Floyd R. Eastwood, New York University; Robert Kiphuth, Yale University; Howard Starr, Colgate University; Larry LaBree, Purdue University; Sidney Hazelton, Dartmouth College; R. J. Delahanty, Dartmouth College.

A questionnaire was sent to four hundred and twenty-five former college swimmers who are now residing in all parts of the world. These swimmers competed during the years between 1910 and 1931. They were sent to swimmers who had earned their letters at the following institutions.

Yale University	314
Springfield College	75
Colgate University	12
Purdue University	12
New York University	12
Total	425

Of this number of 425 there were 206 replies received, 186 of these from men in the United States, 1 from Cuba, 1 from Canada, 7 from Hawaii, 2 each from England, France, Spain, China, Russia, Philippines, and 3 unknown.

Every one of these men had earned their letters while at college. Those returning questionnaires who did not earn their letters were not tabulated in the results and are not counted in the total of 206. This fact insured that those considered had had a considerable amount of swimming activity during a certain period of time.

Of this total of 206, there were found to be 76 (Graph A) who

answered question number 9, "Are you troubled with sinusitis now?" in the affirmative. This is a percentage of 36.9. Of these 76 who admitted sinus trouble, there were 42, or 55.2 per cent, whose statements were backed by the opinion of their physicians (Graph B).

There were 24 of the total of 206 who admitted the presence of sinus infection before their swimming activity. This is a percentage of 11.6. Of these 24 however, only 6 were backed up by the opinion of their physician. A percentage of 25 (Graph B).

From the foregoing two percentages of sinusitis before and after the activity (11.6 before the activity and 36.9 after the activity) the percentage of increase of sinusitis due to swimming activity is 25.3 per cent. However, if we consider only those who were backed up by their physicians' opinion, the percentage of increase is 30.

Under the question number 2, "How many times did you receive your swimming team award?" the results are as follows (Graph C):

Swimmers receiving letter	Number of Swimmers	Percentage of Sinusitis
1 year	51	33.3
2 years	50	48.
3 years	47	34.
4 years	44	34.1

It seems that the men participating in swimming for two years have the greatest amount of sinus infection. It would be natural to assume that the men swimming for four years would be troubled the most but it is not born out by the facts.

The following table was compiled as a result of question number 2A. "What year were you awarded your swimming team letter?"

Year	Number of Swimmers	Percentage of Sinusitis
Before 1910	11	36.3
1911 to 1915	15	20.
1916 to 1920	39	38.5
1921 to 1925	61	36.
1926 to 1931	65	24.

In the following table (Graph E), the results of the question, "What events did you participate in?" will be found with the sinus percentage in each group.

Event	Number of Swimmers	Number having Sinusitis	Percentage of Sinusitis
Plunge for Distance	18	9	50.
440 yd. Swim	27	12	44.5
Back Stroke	7	3	42.
Water Polo	80	32	40.
220 yd. Swim	43	17	39.5
Fancy Diving	46	16	34.7
50 yd. Swim	76	25	32.8
100 yd. Swim	62	20	32.2
Breast Stroke	9	1	11.1

It must be remembered that in many instances one swimmer competed in two or more events, which must have had some bearing on the final outcome.

The plunge for distance with a percentage of 50, and Water Polo with 40, bear out the statement of Norman E. Freeman: "I used to swim under water a great deal and believe it is almost impossible to avoid the entrance of water up the nose in such an activity"[4]

The following table grouped the swimmers in four classes according to the method of exhaling during swimming and shows the sinus infection found in each group (Graph H).

Method	Number of Swimmers	Percentage of Sinusitis
Through the nose	52	32.6
Through the mouth only	38	39.7
Through the nose and mouth	96	38.5
Through the nose with the mouth open	29	24.1

According to these results, the newer method of exhaling, through the nose with the mouth open, affects the sinuses the least.

In the following table the sinuses affected were checked as follows:

Sinuses	Number of men affected
Frontal	38
Mastoids	18
Maxillaries	16
Sphen-ethmoidals	9 (Graph K)

Specific Conclusions.

1. Nearly 37 per cent of the swimmers in this study were affected with sinusitis.

2. There was an increase of 25 per cent of sinus infection during the period of activity.

3. The plunge for distance (now discontinued as inter-collegiate event) had the most detrimental effect with a percentage of 50.

4. Breathing out through the nose, preferably with the mouth open, affects the sinuses the least, as only 24.1 per cent reported trouble.

5. A percentage of 23.8 of the swimmers involved in this study had trouble with their ears.

6. The frontal sinuses are the ones most affected by swimming activity, 50 per cent.

7. Seventy-one per cent of the 76 swimmers with sinus infection report disagreeable after-effects from a common "cold."

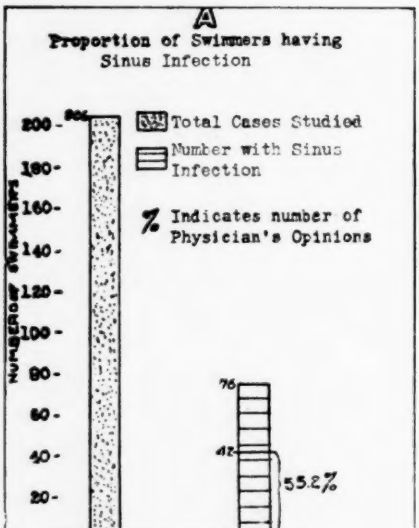
8. Nearly 50 per cent of those with sinus trouble stated that swimming was the cause of their trouble.

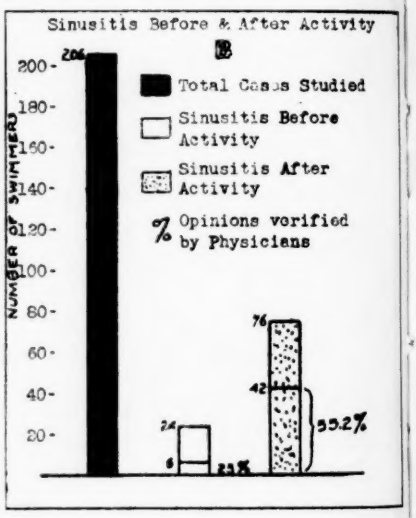
[4] Norman E. Freeman, Personal Correspondence.

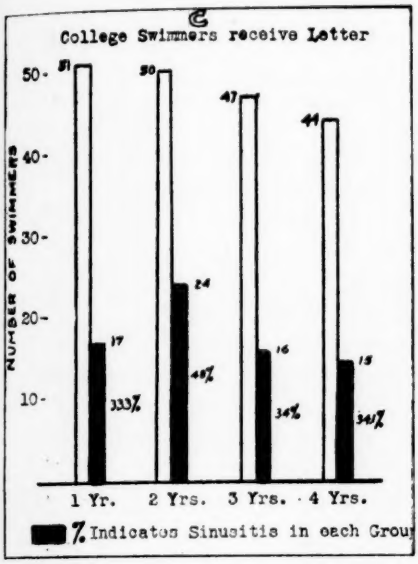
General Conclusions

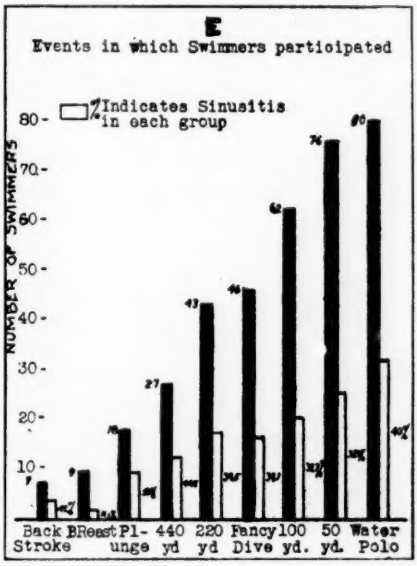
1. From the standpoint of sinusitis, water in which a person swims should be of greater purity than the water one drinks.
2. Ear stoppers are utterly useless in preventing infection to the ear.
3. For practical purposes, complete sterilization of swimming pools is not considered to be always possible.
4. The experienced swimmer is less likely to experience sinus trouble than the beginner.
5. Salt water causes fewer respiratory troubles than fresh, probably because the taste warns the swimmer to keep the water out of his mouth and nose.

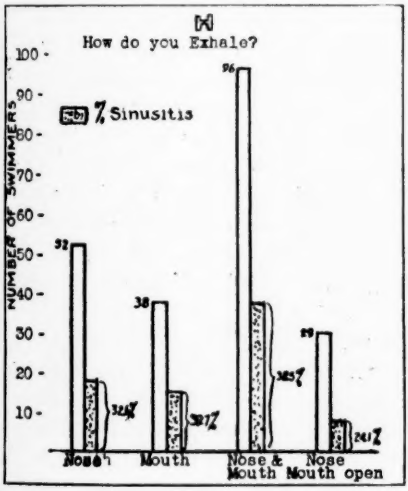
The following graphs will help the reader visualize more fully the contents of this paper.

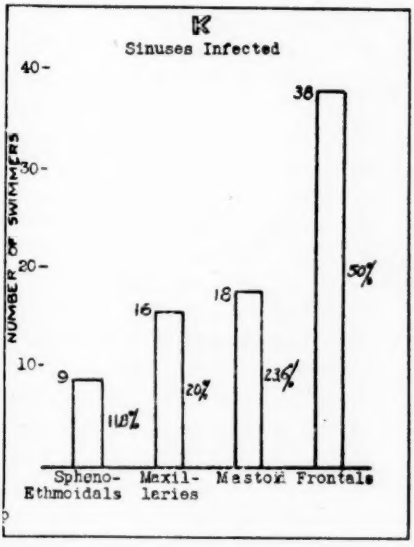





C
College Swimmers receive Letter
NUMBER OF SWIMMERS
50
40
30
20
10
51
17
33⅓%
50
24
48%
47
16
34%
44
15
34%
1 Yr.
2 Yrs.
3 Yrs.
4 Yrs.
% Indicates Sinusitis in each Grou


E
Events in which Swimmers participated
% Indicates Sinusitis in each group
NUMBER OF SWIMMERS
80
70
60
50
40
30
20
10
9
4%
9
11%
18
8%
27
12%
43
16%
46
15%
62
19%
76
25%
80
40%
Back Stroke
Breast
Plunge
440 yd
220 yd
Fancy Dive
100 yd.
50 yd.
Water Polo


M
How do you Exhale?
% Sinusitis
NUMBER OF SWIMMERS
100
90
80
70
60
50
40
30
20
10
52
32%
38
38%
96
38%
29
24%
Nose
Mouth
Nose & Mouth
Nose Mouth open


K
Sinuses Infected
NUMBER OF SWIMMERS
40
30
20
10
9
11%
16
20%
18
23%
38
50%
Spheno-Ethmoidals
Maxillaries
Mastoid
Frontals

A Study of Current Practices in Student Teaching and Supervision

By C. O. Jackson

Supervisor of Student Teaching in Physical Education
University of Illinois

DURING the past twelve years, the number of teachers in Physical Education has more than doubled, and in approximately the same time, the number of institutions offering courses in the training of teachers of physical education has increased to nearly two hundred and thirty. Along with the increasing realization on the part of educators and administrators of the value of and the necessity for a broad, big-muscle program of carry-over activities has come the felt need for better training of teachers in that field.

Today, more than ever before, the beginning teacher has difficulty in securing his first position, due primarily to the ever increasing number of graduates of schools of physical education, and secondarily, to the fact that administrators realize the value of actual experience, and therefore prefer not only college graduates, but those with some experience. One possible solution suggested by Scott is that "we need fewer and better schools preparing men to teach physical education,"[1] but while this would help, it undoubtedly will be years before anything can be done to bring this about. However, in order for graduates of courses of physical education to secure positions where they will have reasonable chances for success, the majority of the curricula in physical education schools must be changed and more time, energy and research devoted to giving as much of the right type of experience as possible, while the student is still an undergraduate. It might be added that along with experience in teaching situations must go guidance and assistance by a competent and friendly supervisor.

With this conviction in mind, the writer sought information as to the policies and procedures with reference to student teaching and supervision in teacher training institutions. Through the cooperation of the Bureau of Research at the University of Illinois, one hundred and thirty-nine questionnaires, accompanied by a letter and a stamped, addressed envelope were sent to all colleges, normal schools, state teachers colleges and universities, listed by the American Physical Education Review as offering a four-year course leading

[1] H. Scott, Talk before A. P. E. A., 1931.

to a Bachelor's Degree in Physical Education. Eighty-three questionnaires, or 59%, representing thirty-one states, were returned, and of that number, seventy-six were in such form that they could be used in this study.

Copy of the Letter Sent to 139 Teacher-Training Institutions

Dear Sir:

In cooperation with a member of the staff of the Department of Physical Education, we are making a study of Student Teaching and Supervision in four-year professional courses in Physical Education and Athletic Coaching. This study is intended to include all work of this type offered in colleges and universities.

Will you be kind enough to assist us in this study by underlining the proper words or expressions and filling in the blanks on the enclosed sheet, and then returning it to the Bureau of Educational Research? We shall be glad also to receive any additional information or material dealing with the topic which you wish to send us. If you desire a condensed summary of the findings, please indicate this by placing a check in the lower right-hand corner of the other sheet.

Very truly yours,

Questionnaire Sent to 139 Teacher-Training Institutions

STUDENT TEACHING AND SUPERVISION IN PHYSICAL EDUCATION

Please underline the proper word, or *insert* the desired word or figure after each question or statement.

1. Is Student Teaching in Physical Education required? Yes. No.
2. Are there any pre-requisites? Yes. No. These are:
   (a) Junior standing. (b) Senior standing. (c) Experience.
   (d) Previous courses. (e) Scholastic standing.
   (f) Recommendation. (g) .....
   .....
3. How many total clock hours of Student Teaching are required?
   How many are optional? .....
   .....
4. Is credit given for Student Teaching? Yes. No. How much?
   .....
   How many clock hours of class work give this much credit?
5. Is any option allowed the Student Teacher in choosing his teaching classes? Yes. No.
6. Do you employ a supervisor for Student Teachers? Full-time, part-time, no. His duties, in addition to supervision, are:
   (a) Coach. ..... (b) Director of Physical Education.
   (c) Intramural Director. (d) Instructor in Physical Education.
   (e) Dean of Men. (f) Dean of School. (g) .....
7. What form of guidance or assistance is given Student Teachers by the supervisor? (a) Help in choosing classes. (b) Conference.
   (c) Meetings. (d) Class visitation. (e) Mimeographed or printed material. (f) Demonstration teaching. (g) .....
   If meetings or conferences are held, how often? .....

8. Do Student Teachers take a course in Methods? Yes. No. By whom given: (a) Supervisor of Physical Education. (b) General Supervisor. (c) Instructor or Professor in Education. (d) Director of Physical Education. (e) .....
9. Student Teachers are graded by: (a) Supervisor. (b) Instructor. (c) Director of Physical Education. (d) .....
10. What is the average number of Student Teachers per term, quarter, or semester, in Physical Education? .....
11. Student Teaching is done in the following situations:
    (a) Elementary. (b) Junior high. (c) Senior high. (d) Normal. (e) College. (f) University. (g) Professional P. E. courses. (h) Clubs. (i) Playground. (j) Y. M. C. A. (k) Churches. (l) .....

Answered by (name and position) ....
School .....

If you desire a condensed summary of this report, please indicate by making a check at the right. Use the back of this sheet for any additional information.

In presenting the data, universities and colleges will be considered as Group I, State Teachers Colleges and Normal Schools as Group II, and three Women's Colleges as Group III. It was not the intention to survey conditions in Women's Colleges, but since, through an error in addressing, three questionnaires were sent out and returned, they have been included in the study.

TABLE I

NUMBER OF SCHOOLS IN EACH GROUP REPORTING THEIR PRACTICES CONCERNING THE ITEMS SPECIFIED

	Group I		Group II		Group III	
	Yes	No	Yes	No	Yes	No
Required student teaching	47	1	25	0	3	0
Pre-requisites	47	1	23	2	3	0
Credit given	46	2	25	0	3	0
Option of courses	32	16	25	0	2	1
Methods required	48	0	24	1	3	0

Some interesting facts are brought out in Table I, which combines the data from five tables. The schools in the three groups studied are practically unanimous in requiring student teaching in physical education, in giving credit, and in requiring a course in methods, but the pre-requisites differed considerably. The most common are (1) previous courses, varying from courses in Physical Education to courses in Education; (2) a certain number of hours of Education; and (3) junior and senior standing, in the order listed. Scholastic standing and recommendations are also indicated as being important. The University of California requires not only a B.S. degree and certain courses in Education but, in addition, the

student must maintain a definite scholastic average in order to receive a general certificate at the end of his teaching period.

The tendency seems to be to require a definite amount of student teaching, and only eleven schools in the study allowed the student to take more, if he wished. The University of Cincinnati requires two semesters of student teaching, starting in the junior year, three hours a week for two hours credit. In the senior year, two mornings a week, from eight-thirty to twelve, are devoted to teaching in the elementary or high schools with a credit of six hours for the year. The University of Oregon allows each student teacher to elect work in either the regular physical education courses, or in the schools of the city and surrounding towns, and Temple University places the student teachers in nearby towns and also permits most of them to do extra teaching without credit.

Only four of the schools studied, two each in the first two groups, employ a full-time supervisor of student teaching, and only one supervisor, at Springfield, is directly in charge of the student teaching in physical education, while the remaining three are general supervisors for all student teachers. Since sixty-six of the group studied employ part-time supervisors, it is interesting to note what their additional duties are.

The most common duty, in addition to supervising of student teaching, is acting as instructor in Physical Education. Next, in order, is performing the duties of Director of Physical Education. The practice seems to be to combine several offices for one individual to fill, and the combination of coach, director of physical education, and instructor in physical education seems to be most common. In a surprisingly large number of instances, the supervisor is in reality the coach of the local high school, as well as instructor in the university or college. The smaller the school the greater seem to be the number of responsibilities vested in one individual, but it is interesting to note that at the University of Illinois, with the second largest number of student teachers in the study, the same situation exists. There, two instructors divide the student teaching supervision between them; in addition, one handles the junior football and basketball leagues and is Freshman baseball coach, while the other is coach of the Student Circus and instructor in Physical Education and Athletic Coaching. In some instances, students are taking work simultaneously under the supervision of both men.

As indicated in Table II, the traditional conference, either before or after the teaching period, or both, is used by the majority of the schools in the three groups; demonstration teaching, class visitation, and meetings follow in order. It is possible that the arrangement at Illinois, where some form of student teaching actually begins in the freshman year, while not reported in any other questionnaire except that from Wisconsin, may be the practice in some other

TABLE II

NUMBER OF SCHOOLS IN EACH GROUP REPORTING THEIR PRACTICES CONCERNING GUIDANCE FOR STUDENT TEACHERS

	Group I	Group II	Group III	Total
Conference	40	24	3	67
Demonstration teaching	34	22	3	59
Class visitation	34	20	2	56
Meetings	27	16	2	45
Materials (printed, etc.)	18	16	1	35
Choosing classes	18	11	2	31

schools as well. Many elementary courses in the professional curriculum of Physical Education are broken up into teaching units where the individuals first teach each other and then, as they acquire confidence, teach larger groups. Their own classmates, assisted by the instructor, act as friendly critics. The most frequent combination as indicated in the study is conference, meetings, demonstration teaching, and class visitation.

The most common practice as indicated by the report from thirty-three schools is to have meetings weekly with the supervisor. Twenty schools, or 26.7%, failed to report whether any meetings were held. The remaining twenty-three report a great variety of practices, such as meetings after each period, daily, two and three per week, monthly, at call, irregularly, and when necessary. Harvard Summer School lists daily meetings, and East Stroudsburg, Pennsylvania, indicates three meetings weekly. Northern Teachers, Marquette, Arizona State Teachers College, Ohio Northern, and the University of California all require two meetings weekly with the supervisor. The University of Texas has weekly meetings, in addition to meetings after each lesson taught, while the University of Wisconsin has a meeting after each lesson. Skidmore College for Women states that meetings are held daily at first, and then as often as necessary, while Ball State Teachers College, Indiana, requires attendance at one general conference weekly, with individual conferences after each visitation by the director, as well as other conferences when requested by the student or when deemed necessary by the director. At the University of Illinois, one or two conferences, in addition to weekly meetings, are held each semester and where circumstances warrant it, more conferences are held; but in all cases, each time a student is observed in his teaching, some helpful comment is made to him by the supervisor immediately afterward.

In the majority of cases the schools studied report that a course in Methods of Teaching is given the student teachers either by (1) the supervisor of physical education; (2) an instructor in physical education, or a professor in Education; (3) or the director of physical education. It must be clear, however, that in a number of

instances, although not specified definitely in the questionnaires these three or four persons are in reality the same individual. In other cases, where a course in Methods is reported, it is probable that several courses in Methods of Teaching are required, some taught by the Department of Physical Education and others by the Department of Education. One important fact was brought out in several of the answers to this question. In some cases where the one course in Methods is taught by a professor of Education, friction may arise. The following quotation from one of the questionnaires illustrated this perfectly: "The practice teaching course is given by the Education Department, and the Physical Education Department has nothing to say about the supervision or the Methods course. We may have what we consider a fine physical education teacher, and in taking the practice teaching course he may receive a poor grade, due to a few pet theories or whims of the professor of Education teaching the course." This may be an exceptional case, but it certainly indicates some of the difficulties which may arise where someone outside of the department controls the student teaching situation in physical education.

The person responsible for the grading of student teachers is, in most instances, the supervisor of physical education, with the instructor of physical education, and the director of physical education following in the order named. While there is of course the possibility of one individual being listed two or more times, and not so indicated in the questionnaire, in the majority of cases, undoubtedly, final grades are a combination of several judgments, those of the instructors under whom the student teaching is performed, and those of the supervisor. At the University of Illinois, it is possible for a student to elect teaching in several courses under different instructors during the same semester. Tentative grades are reported on a special grade sheet by the instructors twice a semester, and the final ones are averaged with those given by the supervisor, which are based on observation, accomplishment in written and oral work, as well as ability.

Ball State Teachers College, Indiana, reports that the grading is done by the Director and the critic working together, while Santa Barbara State College, California, indicates that the City Director of Physical Education and Recreation not only places the students in the school system, supervises them, holds one meeting weekly, gives demonstrations, but grades them as well. At Iowa State, each student is graded by the instructor under whom he teaches, and the course supervisor simply assembles and compiles the grades, using a form questionnaire to assist in obtaining comparable marks.

In the majority of cases, the student has more than one choice of the place or grade level where he will carry on his student teaching, and in most schools this includes either teaching in the elemen-

TABLE III

NUMBER OF SCHOOLS IN EACH GROUP REPORTING SITUATIONS IN WHICH STUDENT TEACHING IS CARRIED ON

	Group I	Group II	Group III	Total
Senior High	41	24	2	67
Junior High	36	23	2	61
Elementary grades	22	23	1	46
College	15	11	2	28
Playgrounds	14	9	2	25
University	24	..	..	24
Professional courses	15	6	1	22
Y. M. C. A.	8	4	..	12
Clubs	6	3	1	10

tary grades, junior or senior high school, college, or university classes, or in the professional Physical Education courses, in all forms of combinations. In a few cases not listed in Table III, student teaching is done also in churches, intramurals, and faculty classes. Faculty classes are reported in only two cases, but there may be other situations comparable to that at the University of Illinois. There a student may be one of four or five selected individuals who assist with faculty recreation and handle such activities as volleyball, handball, and swimming, or he may elect to do part of his student teaching in officiating for intramural games.

Perhaps the typical student teaching arrangement can briefly be illustrated by a composite of the practices in use at the present time in the schools studied. In such a typical set-up, student teaching with credit is required, with certain pre-requisites, such as previous courses and junior standing; and little opportunity for more than the required amount is offered, although some option is given for choice of teaching situations. The student teachers are guided by a part-time supervisor who is also the director of physical education (in the smaller schools), instructor in physical education, and coach of some sport. The assistance he gives consists of the traditional supervisory methods of conference, meetings once a week, demonstration teaching, and class visitation. He teaches a required course in Methods of Teaching, and determines the final grade for each student, on the basis both of observation and the grade turned in by the instructor under whom the teaching was done. Practically all of the student teaching occurs in the junior and senior high school, with limited opportunity afforded for teaching in the elementary grades, on playgrounds, and in college and university situations.

An Experiment in the Testing of Ability and Progress in Basketball

By H. D. Edgren

Department of Physical Education, Chicago Y. M. C. A. College

PART I

Previous Experimentation in Basketball

This article is an attempt to list the results of studies in the field of basketball and to indicate the method used in recent studies by the author. It is hoped that both the results and the method used may prove stimulating and helpful to fellow physical directors to engage in experimentation and change methods of teaching and coaching based on new discoveries.

In 1914, Mr. Cummins made a study of the effect of basketball practice on motor reaction, attention and suggestibility. Motor reaction was judged by tapping and steadiness test; attention, by the cancellation of various letters, misspelled words and a simultaneous adding test; and suggestibility, by the progressive lines illusion and the progressive weight illusion. These tests are very fully described in his article.[1]

The following conclusions are based on his study: Persistent practice of basketball breaks up motor reaction by reducing the rate of voluntary movements and rendering the subject less steady in point of involuntary movements.[2] This same exercise increases the subject's power of attention.[3] It also renders the subject more susceptible to suggestion. These tests by Cummins were one of the early attempts to judge basketball by physiological and psychological tests.

In 1922, a Mr. Noble conducted an experiment to study the acquisition of skill in throwing basketball goals. His main concern was to test the transfer of efficiency from a given drill to a game situation. When the men who had taken the drill were tested against the game situation these men showed a positive increase compared with their rating before the drill practice.[2]

We have a more recent investigation by Mr. Coleman Griffith of the University of Illinois, who has contributed more to experimentation in basketball than any other single individual. The results of some of his observations are included in the following paragraphs.

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1 R. A. Cummins, *Psychological Review* (1914), p. 556-569.
2 A. Noble, *School and Society* (1922), p. 342-344.
3 Coleman Griffith, *Athletic Journal*, "Experiments in Basketball," (June, 1929).

Recent changes in basketball tactics have made possible an increase in the stress and use of psychological fundamentals.

"The two important changes are the short pass game and the fast versus the slow break. In this new type of play, the players develop a feeling or 'instinct' or intimate sense of team relationships. This is in all probability dependent upon a new visual habit which the player has developed."[4] In ordinary vision we use only the center of the retina and call that focal vision, but in basketball it is necessary to attend to things which we do not see with the center of our eye. To be both efficient and deceptive a good basketball player must develop his indirect or peripheral vision. The dribble is a good example. It is easy to dribble a ball when looking directly at it, but an individual must also see opponents and team-mates while dribbling so that indirect vision is the only efficient method of watching the ball. Mastery in this department of the game depends not only on indirect vision but also on a delicate sense of touch, for the ideal player is master of the ball without paying any attention to it.

This short, fast passing type of game demands the ability to keep the head still, see the entire floor and still catch the ball. It is a known fact that the eye in movement has periods of flight and of perch, and it is only during the perch that vision is clear. It, therefore, becomes important that we keep our head and eyes still when attempting to catch a moving ball. The failure to stress this psychological fundamental has undoubtedly been the cause of much fumbling of the ball in this game of basketball.

"There are but few coaches and instructors of basketball who recognize the mental phases of this game of physical skill. The frame of mind or 'mental stance' of an individual plays an important part in the development of bodily skills. The dependable man or consistent player is one who backs up bodily skills with an undisturbed mind. The erratic player has his ups and downs because he has never acquired mental stance. His skills are subject to every passing change in the nature of his thoughts and feelings. Free-throw shooting is an example. If a player has two throws and his first throw is short his next throw will be long if he becomes concerned about it. The player with mental stance will not become concerned but will make his second throw according to his habit of throwing free-throws. The first thought is usually the result of habit and the second thought is in conflict with this habit. If individuals are to have a proper frame of mind in the game, the same mood and temperament must be practiced during training periods. Over-confidence is another example of a change in mental attitude. Here, success has interfered with long practiced attitudes and frames of mind."[4]

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4 Coleman Griffith, *Athletic Journal*, "Experiments in Basketball," (June, 1929).

The following statements are the results of tests developed and used in the research laboratories at the University of Illinois.

1. Fatigue Test—
   A rest period of *two minutes* in every *five* during practice sessions showed a positive correlation of 17% increase in efficiency.
2. Shooting skill—
   (a) Errors in direction—
   This is due to the use of unequal strength in each hand and to an unequal rate of speed at which each strength is applied.
   (b) Errors in distance—
   This is caused by poor judgment of distance.

The correction of direction errors is made rather easily but this is not equally true of distance errors. To remedy distance errors players must acquire skill in making muscular as well as visual judgment of distance. Mr. Griffith recommends the blindfolding of men to develop this muscular feel.

3. Zone for shooting—
   (a) There is a definite decrease in skill with increase in distance from the basket.
   (b) This decrease in skill is not as great directly in front of the basket as it is to the left and right.
4. Shooting while in motion—
   Tests indicate that when speed of motion is doubled, decrease in efficiency is doubled. It is therefore important to practice shooting while in motion.

The following is a report of studies undertaken by the author in experimentation in basketball.

1. Observation study of basketball shooting. The attempt was made to determine whether distance or direction is the greater factor of inaccuracy in shooting.
   Charts were used in recording the missed shots. The recorders noted whether the ball hit short, long, left or right. This was done for both free throw shooting and for field goals during a schedule of ten games of an intramural schedule.

RESULTS

Games	*Teams*	*Missed Goals*	
		Direction	*Distance*
		FREE THROW	
10	12	23 or 30%	55 or 70%
		SHOOTING	
10	12	182 or 42%	252 or 58%

The above results indicate that the greater error in accuracy both in free throws and in goal shooting is due to distance error. The ability to propel the ball with an even amount of power giving good direction is learned sooner than the distance perception and muscle feel for distance.

The following eight basketball tests were given as a means of testing the progress and skill of a beginners' basketball class. The entire class was given a pre-test at the beginning of the course and a final test at the conclusion of the course.

Results: An average increase in ability in the total class of 20.1% with the range of increase varying between 7.2% to 50% increase.

The author is convinced from this experience that progress in the fundamentals can be measured. There are two apparent values to this type of experimenting:

1. Individual instruction is enhanced when the instructor knows the skills of each member.
2. Pupil interest is developed when the pupil can see the progress he is making as shown by periodic testing.

Purpose of the Experiment

This experiment is an attempt to develop and use some tests and measurements in the field of motor ability and in the specific activity of basketball. Although there has been considerable work attempted in the field of physical efficiency, very little has been attempted in the field of motor ability tests. The principal contributions to this field are contained in "Measuring Motor Ability"[5] by Brace, and "Tests and Measurements in Physical Education"[6] by Bovard and Cozens. The writer has been helped very materially from these two sources.

During the past seven years as a basketball coach I have used various means of determining the varied abilities of my men. For the past two years I have used a battery of specific basketball tests as a means of measuring the abilities of all the varsity men in the fundamentals of basketball. Along with these tests we scored all the players on actual playing ability as demonstrated in competition. These tests and scoring methods were reported in a paper entitled "Basketball Efficiency Tests," for the department of Psychology at the University of Chicago.

During the past year my studies have shifted from the varsity player to the many individuals who play basketball in the Y. M. C. A. and school physical education classes and not as members of a team. It is this particular group that needs to be encouraged and helped,

[5] David Brace, *Measuring Motor Ability.* A. S. Barnes & Co., New York.
[6] Bovard & Cozens, *Tests and Measurements in Physical Education.* W. B. Saunders Co., Philadelphia.

but which altogether too often is left to its own resources. My interest here centered around two phases of the problem of measurements. I wanted first to devise a means of determining the progress of an individual in the learning of specific motor skills, and second to develop a combination of tests which when applied might prove an index to basketball ability.

The study concerned itself around three major problems:

1. Can a series of tests be developed which would adequately measure progress in basketball?
2. Can a series of tests be developed which might be used as a means of predicting potential basketball ability?
3. Is there any carry-over from specific basketball skills to general ability skills?

The Materials and Methods Used in the Experiment

1. The groups used were:
   a. An experimental group consisting of thirty members of a beginners' class in basketball.
   b. A control group of thirty members, of varied basketball ability.
2. The tests used were:
   a. Eight tests of specific ability in basketball skill

Speed pass	Dribble
Accuracy pass	Dribble and Shoot
Accuracy shooting	Ball handling
Pivot and shoot	Opposition shot

   Description of tests can be found at end of article.
   b. Four tests of general athletic ability

Agility	Speed
Endurance	Coordination

   c. Brace Motor Ability Tests of Neuro-Muscular Co-ordination.
3. The method:
   The basketball, general ability, and Brace tests were given to the experimental group at the beginning of the quarter, and the basketball tests were given to the control group at the same time. After two months of instruction, of forty minutes per day, in basketball fundamentals, and two weeks of actual play, the experimental group was again tested, to determine whether or not any progress had been made in motor skill. At this same time the control group was again tested to see whether or not any progress had been made in this group which had not been instructed. This group was used primarily in the basketball test to determine the validity of this particular test.

The raw scores of each test have been reduced to T-scale scores, to make all scores comparable and to properly place each student in relation to other students.

At the conclusion of the period of instruction, the experimental group was scored and rated on their actual playing ability as indicated by their performance in organized teams. These data were recorded by student coaches and scorers who watched particular men at play.

The Brace Motor Ability Tests were also given to the experimental group to allow a comparison of three types of tests and to determine whether or not one test had a greater degree of predictability than either of the other tests.

A definite technique of instruction and drills was used during the training period. Twenty different correlations have been made, using the Otis Correlation Method. Sixteen of these are the individual and total basketball and general ability tests which were correlated with the actual playing ability score to determine the reliability of the test. The other four correlations were made between the general ability, basketball ability, and Brace Motor Ability tests.

Results of the Experiment

1. The mean T-score of the basketball tests of the experimental group is: pre-test, 45.5; and final test, 54.1; while in the control group the pre-test is 50.1 and final test, 50.5. The average per cent of increase is 20.1% in the experimental group, with only 4.2% in the control group.

2. The final test average T-score of the general ability tests gave an increase of 17.3% over the pre-test of the same series of tests.

3. The correlations of each of the eight basketball tests with actual ability separated these tests into two groups. Five of the tests had correlations ranging from .42 to .64, and three of them had correlations from minus .13 to .33. The total basketball test correlations with actual play is .73 on the pre-test and .77 on the final test.

4. The individual general athletic ability tests correlations with actual play ranged from .50 to .72 and the total general athletic test was .73 for the pre-test and .77 in the final.

5. The correlation between total basketball test and general athletic tests was .76 for the pre-test and .52 for the final test.

6. The correlation between the Brace Test and general ability is .14, the Brace test with basketball tests is .59 and with actual playing ability is .16.

The Conclusions to Be Drawn

1. The results of this experiment seem to indicate that progress in the fundamentals of basketball can be measured. From the eight tests used in the experiment the author recommends the use of test numbers 1, 2, 4, 5, and 8 as a battery of reliable tests for the measurement of basketball skill in fundamentals.
2. The similar percentage of increase and the high correlation between basketball and general athletic ability proves the close relationship of these two groups of skills even though the correlation of improvement was very low.
3. The lack of correlation in improvement indicates that learned skill in one activity does not carry over in the same amount to another skill.
4. To objectively test an individual for potential basketball ability the test must of necessity measure untaught skills. If this were not so the individual could not be tested on his first appearance and the individual who had never played basketball would automatically be ruled out. The high correlation between general ability test scores and specific basketball test scores on the one hand, and general ability test scores and actual playing ability scores on the other hand, which are brought out in this study, seem to warrant the use of this general ability test as a predictive test for potential playing ability.
5. The advisability of using this series of tests in contrast with the standard Brace Motor Ability test was clearly shown in the poor correlation between the Brace test and General Ability and Actual Ability score, but it must be remembered that the Brace test was designed to test native neuro-muscular ability.

Suggestions for Future Procedures

The author recognizes the limitations of this experiment where only 60 cases were used and therefore does not make any claim of finality, but it is hoped that this experiment may be suggestive to the many physical directors who are attempting scientific teaching in physical education. There are several places in physical education in which this type of effort might be made. The following may be suggestive:

1. Individual instruction is enhanced when the instructor knows the skills of each pupil. This is only possible when each student has been tested in the particular activity in which he is engaged.
2. Pupil interest is developed when the pupil can see the progress he is making as shown by periodic testing.
3. Final grades can be more accurately given when actual scores are present.

4. The coaches of basketball teams will make wiser choices and better elimination of men from their squads when men remain on the squad on the basis of actual performance in tests rather than mere opinion of one man.

PART II

Description of the Various Tests Used

The following tests are designed to test the various abilities of the students in the fundamentals of basketball. In every case an attempt has been made to make the test as true to game conditions as possible and at the same time to make each truly scientific in that it is objective and verifiable.

A. BASKETBALL TESTS

The following eight tests measure only the fundamentals of individual play and do not attempt to consider team relationships.

Test 1. Speed Pass.[1]

This test measures the rapidity with which the student can receive and pass a basketball ten times against a wall. The subject stands behind a line eight feet from the wall and parallel to it. He passes the ball as rapidly as possible ten times against the wall. Time is started when the ball leaves his hand on the first pass and stopped when the tenth pass returns to his hands. The subject must not only stand behind this eight foot line but also receive and pass the ball from behind this line. Any kind of pass may be used.

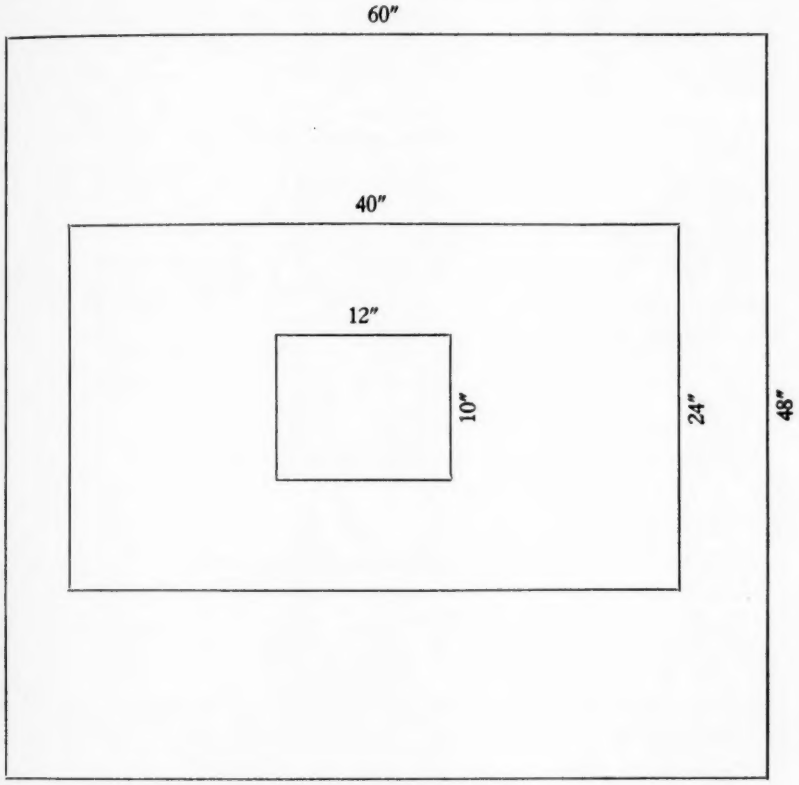
Test 2. Accuracy Pass.[2]

This test is designed to measure the accuracy of the subject in using four different passes. Basketball today demands that the good player have a repertoire of passes and I have chosen to measure four of the most common passes, namely: chest push pass, underhand pass, two-hand shoulder pass and one-hand overhead hook pass. The subject stands back of a line drawn parallel to a target. This line is fifteen feet from the target in the case of the chest and underhand passes, and thirty feet from it in the case of the shoulder and hook passes. Five throws are made with each kind of pass. The ball may be passed at any speed, for accuracy alone is being tested. Passes are scored on the following basis:

Inner square or line marking it.....3 points
Middle square or line marking it.....2 points
Outer square or line marking it.....1 point

[1] D. K. Brace, *Motor Ability Tests*, Macmillan Co., (New York, N.Y., 1927), p. 75.
[2] Ibid.

DIAGRAM OF TARGET ON THE WALL



This size target is used, for it approximates the reach of an individual in catching a ball.

Test 3. Pivot and Shoot.

This test is constructed as a measure of shooting accuracy when the shot is attempted immediately following a pivot. The subject stands anywhere behind a line drawn through the far end of the free throw circle and parallel to the bank-board.

He turns and shoots immediately at the basket without advancing toward it. He takes five such shots and is given one point for every basket made. There is no attempt at speed between throws. The turn is made similar to a backward pivot and the shot follows without any pause.

Test 4. Speed Dribble.

Even though speed is not always desirable in dribbling, the efficient dribbler is able to dribble with great rapidity. This test is

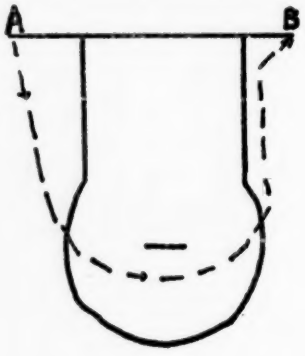
developed to test the subject's ability to manipulate the ball around objects. The subject is urged to go as fast as possible but to keep the ball under control. The watch is started when the subject leaves the starting line at "A" and is stopped when he crosses the starting line at "B." (See diagram.) Score in tenths of seconds.

15′ to first box or chair, 6′ between remaining objects.

Test 5. Dribble and Shoot.[3]

The object of this test is to measure the ability of the subject to handle the ball when he is forced to combine a dribble, a short shot, retrieving the ball on the rebound, and repeating the procedure. He is urged to score as many baskets as possible but to make the five trips as fast as possible. The subject starts at "A," dribbles around the free-throw line, and takes a short shot as he approaches the basket. He then retrieves ball from basket and repeats the process a total of five times. The time is taken from the second that he leaves the line at "A" until he recovers the fifth shot from the basket.

He is scored by dividing the number of baskets made out of the five attempts into his total time in seconds.



[3] Ibid.

Test 6. Accuracy Shooting.

This is a test to measure the distance and direction judgment of an individual when making free throws. One point is scored for each free throw made out of ten attempts with regular game rules of ten seconds for each throw. However the subject may take as much time as necessary between the throws. He must leave the circle after each attempt. This is done to make the test more true to the game situation.

Test 7. Opposition Shooting.

Short shooting is a fundamental that all players should master. However, to make a short shot when one is not hurried is far from what happens in the game. The author has constructed the following test to measure the subject's ability to make baskets when placed in a hurried and trying situation. The subjects are paired with men of approximately equal ability working against each other. Note in

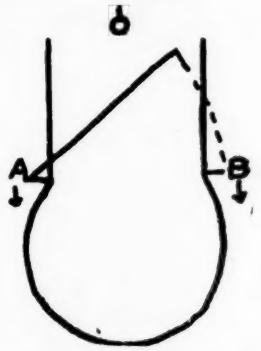


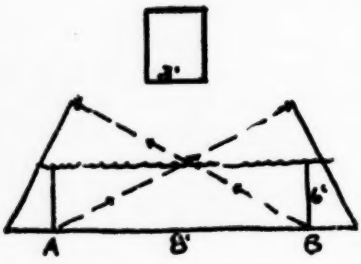
diagram that subject at "B" has a shorter distance to cover than his opposition at "A." Subject "B" has the ball; opponent is at "A." They are both facing away from the basket. At a given signal from the tester, who cannot be seen by either "A" or "B," both turn and go forward, "B" dribbling in for a short shot and "A" attempting to prevent him without making a foul. Each subject is given five points and scores one point for each basket made.

Test 8. Ball Handling.

This test is constructed to measure the subject's ability in ball handling and body coordination. He must pass the ball, follow the ball with the body, receive the ball, stop forward progress, and start back in the opposite direction.

A three foot wide mat about two inches thick is hung on the wall in the center of a six foot lane. Another line is drawn on the floor eight feet from the wall and at right angles to the six foot lane. The ball must always be thrown from behind the eight foot line and outside the six foot line.

The subject starts at "A" and on the signal throws the ball against the wall across and outside of the mat and receives the ball at "B." Here he immediately passes from "B" across mat as indicated by dotted line and receives ball at "A." The subject may carry the ball back to "A" or "B" before throwing the ball if he chooses. He makes ten passes and the time is started when the ball leaves his hands on the first pass and is stopped when he recovers the tenth pass.



B. GENERAL ABILITY TESTS

The following general ability tests were constructed to determine the general athletic ability of each individual.

1. Speed Test.[4]

This test was used to determine the speed with which the subject could travel a given distance when forced to run around objects situated at different intervals. (See diagram.)

The subject was asked to make two complete trips—starting at "A" and finishing at "B." The time was recorded in tenths of seconds.

[4] F. W. Cozens, *Measurement of General Athletic Ability in College Men.* University Press, (Eugene, Oregon, 1928), p. 138.

2. Agility Test.

This test was designed to measure the ability of the individual to lift his body directly upward with a jump and a reach. The distance of the jump was recorded by measuring the difference between the highest point of a standing reach and the highest point of a jump reach. A ¾-inch piece of chalk is used for the entire test. To get the full benefit of the jump the subject must stand close to the wall and jump parallel to it.

3. Coordination Test.

This test was devised as a means of judging the ability of an individual to shift his body from left to right similarly to the way a basketball player is forced to do when guarding an opponent. The subject must work with the feet spread in a good base and must then shift the body across an eight foot lane. The subject worked inside the lane and needed only to touch the line with the outside foot on each shift. He was scored on the time it took to make ten shifts from left to right and from right to left. One shift across counted as one time.

4. Endurance Test.[5]

This test was developed from the stair test suggested by the Misses Collins and Howe of Wellesley College. It was used to determine the efficiency of the subject in working under fatiguing conditions. The subject was required to run up and down a flight of stairs ten times, taking as many or as few steps as he needed. The time was recorded after each single trip and the grand total indicated at the conclusion of the tenth trip.

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BOOK REVIEWS

HEALTH AND HUMAN WELFARE. William E. Burkard, Ph.D., Raymond L. Chambers, Ph.D., Frederick W. Maroney, M.D. Lyons & Carnahan. 532 pp.

This book fills a long-felt want in the health education field at the secondary school level. There has been a paucity of worthwhile material and publications for this particular group. The book is an outstanding contribution particularly for the junior and senior high school period. It is very comprehensive, including much worthwhile data which will require a well organized school program if the entire book is to be covered in one school year. Many parts of the book will be too far advanced for students if their school career has not been influenced by other health material preceding the study of the present volume.

Many phases and sides of health are touched upon—the mental, moral and social, as well as the physical. The book is well organized for teaching purposes, being divided into three parts:

Part 1—A historical background of the health lessons from the past, called "Health Progress Through the Ages."

Part II—A discussion of certain special topics of particular significance to the secondary school student, including chapters on Nutrition and Diet; the Endocrine Glands; Adolescence; Hygiene and Work; Care of the Baby; The Care of the Sick; The Prevention of the Common Cold.

Part III is given over to a review of personal hygiene, being quite inclusive and allowing for an individual check-up on the establishment of desirable health habits.

The book is profusely illustrated with original sketches. These are excellent and convey many thoughts much more clearly than by written word. At the end of each chapter exercises are given as an aid to the student, these exercises generally being divided into three parts:

1. *Study* which tends to fix the subject material of the chapter in the mind of the student.

2. Questions for *discussion* in the class.

3. Questions primarily aimed at *health habit formation.* These questions should stimulate thought and class discussion of the material presented.

The book is attractively bound, well printed with large type, and excellently edited. The scientific material presented in the book, generally speaking, is as authentic as possible in an elementary book without going too greatly into detail. The book can be recommended for the purpose and field for which it was written.

Clair V. Langton, D.P.H.,
Dean, School of Health and
Physical Education, Oregon
State College, Corvallis.

ICE HOCKEY. Alexander Sayles and Gerard Hallock. A. S. Barnes & Co., New York. 1931. 130 pp. $2.00.

This is a book with an immediate appeal to the ice hockey coach. Comparatively little is known about the teaching and coaching of this thrilling sport. Alexander Sayles, Hockey Coach of Williams College, and Gerard Hallock, Captain of St. Nicholas Hockey Club, New York, have gathered together all the good material and presented it in a way in which it can be taught to boys in the most effective manner.

The authors give the history and development and then begin with the fundamentals, stressing: how to skate, pass the puck, shoot, stick handle, and position play. There are also attractive illustrations to show clearly the correct form. If followed closely, even the novice cannot fail to know the game and how to play it. By constant practice of the fundamentals, so carefully explained in this book, the coach can develop a team which will be fast, aggressive, and superior in technique. The chapter on offense is very helpful, showing the style of play used by leading teams in Canada and in the United States. Many helpful suggestions are given, emphasizing the importance of fast skating forwards who rely on passing ability and clever stick handling to win their games.

The book gives eight fundamental principles of defensive play that will check teams composed of individual stars and smooth working combinations. This problem of defense is greatly simplified by the clear method in which the authors present it as it has been tried out and found to be effective against high scoring teams.

Careful discussion and interpretation is given the rules, as drawn up by the National Collegiate Athletic Association.

The "Hints to Players and Coaches" explain how many teams get the so-called "instinctive jump" on their opponents. The training and conditioning of players, which is so vital to success and failure, is also discussed.

The glossary of terms will aid the coach in teaching. High school and college coaches will welcome this dependable edition in teaching America's fastest game.

Tom Prouse,
Member Big Ten Conference Champions 1931.

HEALTH THROUGH LEISURE-TIME RECREATION. Edith M. Gates. Womans Press. 215 pp. $2.50.

"You cannot lead a girl from where she isn't to where she doesn't want to go." This is a sound reminder to adult education leaders.

Miss Gates' book tells the story of the health and recreation work of a pioneering organization from its beginning in 1877, when calisthenics were taught to a class in the first Y.W.C.A. in Boston, by "one of the boarders," and later by Miss Anna Wood of the Wellesley College faculty, on down to the present comprehensive program for health education in the Y.W.C.A.

We see clearly outlined the program of activities planned: (1) to attract the young adult (the Y.W.C.A. works primarily with women from 15 to 35 years of age), (2) to hold her because her real interest is enlisted, and (3) to lead her on nearer to that highest state of abounding well-being that makes real personality possible.

Methods for the basic medical and physical examination, for the varied activities program, and for health teaching, are well described and include much of suggestion for all community leaders in health and recreation.

The chapter on "Health of the Leadership" has stimulating and practical suggestions for every professional woman. How to get recreation and adequate social life into one's program is a serious problem. "It may happen," says Miss Gates, "that as a by-product of planning and teaching the healthy way of life to others she will become inspired to adopt a regime of better health habits herself, but this should not be left to chance; she must definitely direct her life toward reaching her own maximum in health, vigor, poise, and buoyancy of spirit. For instance, 'Walking is a fine art; there are degrees of proficiency, and we distinguish the professor from the apprentice. The qualifications are endurance, plain clothes, old shoes, an eye for nature, good humor, vast curiosity, good speech, good silence—and nothing too much.'" Alas, while in us all there are the makings of a professor in this art, in reality most of us are

only apprentices, from lack of application.

The book has value for all those working in the adult education field, and every Y.W.C.A. worker will be fascinated by the story in the final chapter of what our organization has done at home and abroad in promoting positive health among women and girls through these past fifty odd years.

Well selected bibliographies, at the close of each chapter and in the appendix, stimulate to further study of this adult field.

Leisure-time for the masses of our people is on the increase and the standards for leisure-time programs of active recreation are of vital importance. This book can do much to insure the finest standards for all community programs in health and physical education.

Bernice Amanda Miller,
Y.W.C.A., University of Nebraska,
Lincoln, Nebraska.

COMMUNICABLE DISEASE CONTROL. Report of the Committee on Communicable Disease Control of the White House Conference on Child Health and Protection. Century Company. 1931. 288 pp. $2.25.

Any public health worker, whether in school, clinic, or shop, will find in this report the most recent procedures recorded as effective by experts. There could be no more authoritative source, as a glance at the membership of the committee will testify. Headed by Dr. George H. Bigelow, State Commissioner of Health for Massachusetts, the committee roll includes the names of recognized leaders in medicine, public health, and allied fields of research. That they gave their best to this study is demonstrated by every criterion.

Although a report involving research and statistical tabulations, it is most interesting reading. Moreover, the arrangement of the material and the apparent adherence to a policy of presenting only the essentials in the simplest, briefest form possible, makes it a book of the most practical sort. Furthering this point of excellence is an admirable job of printing.

To indicate the usefulness of this volume to the public health worker, the following outline of "Items Presented for Individual Diseases" is included here. It is used with fifty-two diseases.

I. Etiological Agent
I a. Diagnostic Criteria
  (1) Clinical
  (2) Laboratory
II. Source of Infection
III. Mode of Transmission
IV. Period of Incubation
V. Communicability
  (1) Period and Degree of
  (2) Immunity: natural; acquired
V. a. Statistical Epidemiology
  (1) Prevalence
  (2) Age and Sex Distribution
  (3) Racial Distribution
  (4) Geographical Distribution
  (5) Seasonal Distribution
  (6) Cyclical Distribution
  (7) Mortality
  (8) Case Fatality
VI. Administration Measures
  (1) Investigation of Source of Infection
  (2) Isolation
  (3) Quarantine
  (4) Prophylaxis
  (5) Concurrent Disinfection
  (6) Terminal Disinfection
Special Measures

As would be expected the report deals largely with control measures and surveys concerning child health. This fact alone is a point of merit for it enables the assembling of much valuable information into less space than is usually the case. School physicians and nurses will appreciate this brevity. Indeed, the whole book is an excellent example of what can be done to "weed out" in favor of essentials.

Space does not permit the recording of all the good things that could be said for this report. The reviewer regards it as one of the most practical and usable books for the every day

health worker that will result from the Conference.

Allen G. Ireland, M.D.,
Director of Physical and Health Education, State Department of Public Instruction, Trenton, New Jersey.

LIVING THE LIVER DIET. Elmer A. Miner, M.D. C. V. Mosby Co. 1931. 106 pp. $1.50.

This compact little book of about one hundred pages is an epitome of helpful and practical information on one of the recent important medical triumphs, the treatment of pernicious anemia by the "liver diet." Although it is a handbook for the physician, the nurse, and the dietitian, the author had more than a medical treatise in mind, for he has given the sufferer of this heretofore fatal disease the greatest allies of medicine, hope, and faith, as well as a highly useful dietary guide. Devoid of medical terms and descriptions, the direct, simple style of construction affords the reader a ready grasp of the content which is limited solely to the topic.

A touch of interest arises out of the fact that the author, a physician, is himself a pernicious anemia patient. While such intimacy with the disease is not essential to authenticity, it has provided the opportunity for first hand observation and experimentation, a circumstance which the author has used to good advantage.

One is favorably impressed by the variety of ways and pleasant combinations in which liver can be served. Not only are many recipes made available to the patient, but the principles for constructing diets and the reasons for including the several essential foods are simply and clearly stated.

Living the Liver Diet should prove a most valuable aid to the busy practitioner and the dietitian. It will be an inspiration and a comfort to many sufferers from pernicious anemia.

Allen G. Ireland, M.D.,
Director of Physical and Health Education, State Department of Public Instruction, Trenton, New Jersey.

SCHOOL NURSING. Mary Ella Chayer and Katharine Tucker. G. P. Putnam's Sons. 1931. 292 pp. $2.50.

For years public health nurses have been waiting for a textbook on school nursing. An occasional chapter in a book would deal briefly with the activities of a school nurse, but not assist a nurse, to any degree, to plan her program. A few pamphlets have given meager material for special problems in health education. In the recent volume on school nursing, published by Putnam, the author has made a genuine contribution on health work in the schools. To both the rural and city school nurse, the book will be of practical value. As a former teacher and a school nurse with sound experience, Miss Chayer in her book deals with both health service to children in schools, and the newer program of health education to pupils.

As school nurses have sought for themselves better preparation for their work, so has their usefulness increased in the public school system. The book on school nursing not only discusses the remedial problems the school nurse has, but discusses the health ideal for pupils. In a practical manner, the volume deals with the individual needs of school children. There are plans for correlating the health work of children in a helpful way with teachers and parents. While school nurses have worked for a longer time in elementary schools, there is no reason to believe that their usefulness to the pupil ends at that time. The chapter on "Nursing in Secondary Schools" is remarkably well planned. It deals with the special health problems of this age group, and offers valuable suggestions for the school nurse working with other members of the faculty.

To the school nurse working in small towns, this book will serve as a constant reminder of the broader aspects of health education. To the county nurse, the book will be a

source of sound information as she develops her school program. Many school nurses will read the chapter on "Relationships," and gain a better understanding of the administration practices in school work. A good bibliography and well chosen illustrations add to the usefulness of the volume.

Barbara H. Bartlett,
Professor of Public Health Nursing, University of Michigan.

SCIENCE IN THE SERVICE OF HEALTH. Elliot R. Downing, Ph.D. Longmans, Green & Company. 1930. 320 pp. $2.00.

Dr. Downing has long been known as a leader in the popularizing of scientific knowledge. This book fully sustains his reputation. There is probably no other source from which students may secure a better idea in simple non-technical language of the pioneer investigators of health and their discoveries of causes of disease. Not only is the information reliable and well selected, but it is most interestingly presented.

The book is admirably adapted for use in either the senior high school or elementary health courses in college. As a laboratory manual it offers an unusually well selected list of demonstrations, which are possible of use without elaborate or expensive equipment.

For an introductory text in hygiene or health education the text is admirable. It deserves a very wide acceptance.

G. B. Affleck,
Int. Y.M.C.A. College,
Springfield, Mass.

APPARATUS ACTIVITIES. Alfreda Mosscrop and Helen Hardenbergh. Burgess-Roseberry Company, Minneapolis, Minn. $1.35.

A Descriptive Analysis of Selected Apparatus Events for Girls and Women by Alfreda Mosscrop and Helen Hardenbergh is an interesting compilation of such events as described in the title.

The authors have in mind those teachers who have had little or no practical training in apparatus and self-testing exercises in physical education. The activities are, therefore, analyzed and described in non-technical terms so that any teacher may understand and teach them. The exercises are selected for the needs and use of the comparatively unskilled performers.

The work includes a well selected list of exercises emphasizing hanging, vaulting, momentary support, and events of a strongly stunt nature. The selection appears to aim at the development of strength and skill through simple movements, stunts and exercises which form a basic part of much of the activity in which the girls may engage later on.

The authors have suggested that there is a need for such a volume on the basis that most gymnasia are equipped with apparatus, and that because of its existence it should be used. They have failed to point out any educational significance or suggest the physical benefits that may be obtained from self-testing exercises.

The volume is however, of distinct value to instructors, teachers and students of physical education who are interested in apparatus and self-testing activities as a part of the physical education program for girls and women.

L. J. Judd,
Int. Y.M.C.A. College,
Springfield, Mass.

HEALTH THROUGH PROJECTS. G. D. Brock. A. S. Barnes & Co., New York. 1931. 268 pp. 27 illustrations. $2.00.

The three introductions and preface to this book are unusually interesting. *Introduction A* is a discussion of *project teaching* which recalls Dr. Kilpatrick's philosophy of the project method and applies it to health education. *Introduction B* states briefly the plan of the book, while *Introduction C* ably discusses health as an objective of education. An unusual fea-

ture is the including of references to the introduction. The preliminary part of the book should be read carefully. Every sentence is weighted with meaning.

Each chapter in the book gives the essential subject matter of the topic being discussed. The busy teacher need not search through many volumes to refresh her memory concerning the fundamental facts. References for each topic are given so that anyone may find more material if he so desires. Following the subject matter is a statement of the aims and objectives for the topic. These objectives are broad enough to cover many grades although they are specifically stated.

Suggested projects constitute the third part of each chapter. In the words of the author, these projects "emphasize the what to do." Thirty-one projects are listed under ventilation. They are suggestions to the alert teacher. "The pupils may study some animals which apparently need little ventilation"; and, "They may study animals which prefer open-air sleeping at night" are two that are given on page 21. Primary teachers as well as intermediate can use such suggestions. Perhaps this class is already studying pets—here is an idea for a new integration. A class studying forestry might well be led to study the value of forests to the air we breathe (suggestion 9, page 21).

Sometimes a statement is vague. "Let them tell air stories" and "Let them write compositions on various air topics." The indefinite, the stereotyped projects such as these are in the minority. The *Additional Problems for Study* are stimulating.

All of the topics treated are worthwhile, and should be a part of the health education program. This book in no sense of the word defines a course of study. The material is presented in such form that the teacher is free to use what is given; she must choose her own way of handling, but there are suggestions to guide her and to bridge gaps where her own originality fails.

The book presents modern ideas. In no phase of health work have views changed more radically than in the use of height-weight tables. The author points out that deviation from normal weight is not to be used as a single measure for judging nutrition. He presents the material fairly and in the light of the accepted ideas.

Part II presents score cards of various types for personal and community health. These are stimulating and indicate further opportunities. Suggestions for making posters and graphs should prove very helpful to teachers who have not had art training.

One wonders why the author of so excellent a book did not include in his references the most recent health publications. A few of the 1929 and 1930 books are mentioned, but there are many that are omitted. For example, reports of the "Conference of the American Child Health Association" held at Sayville (1929 and 1930) are not mentioned; yet the material in these reports is excellent and would be an addition to the references given.

The style of the book is interesting. The print is clear and easy to read. The index is worked out in detail and should save the time and patience of those who use this book.

The book is a real contribution to health education. It will prove of value to special health teachers and to those who teach many subjects; it should have a place in the libraries of teacher training institutions.

Mary May Wyman, Supervisor,
Health and Safety Education,
Louisville Public Schools.

NATURE AND SCOPE OF EXAMINATIONS. Volume II of "Interpretations of Physical Education." Edited by J. B. Nash, Ph.D., New York University. A. S. Barnes & Co. 307 pp. $2.00.

Volume II in the series of "Interpretations of Physical Education," entitled *Nature and Scope of Examinations*, is an unusually interesting publication. Seldom does one find a treatise which can be read from be-

ginning to end with such exceeding profit and interest. One theme, namely, the vital relation of the work of the physical educator and the physician, which like a silken thread runs throughout the volume, presents indeed a challenging problem. This treatise represents a genuine contribution in dignifying the profession of the physical educator through the presentation of a host of trustworthy and convincing facts that pertain to an individual's wholesome and successful living.

The interrelations indicated between the organic, neuro-muscular, interpretive-cortical, and emotional-impulsive phases of an individual's experience are of inestimable value in interpreting the real significance and virtue of the work that is being attempted and accomplished by competently trained physical educators. To portray the composite and clear thinking of the sociologist, the physiologist, the neurologist, the physician, the psychiatrist, the psychologist, the philosopher, and the specialist in health and physical education in a single volume represents a real accomplishment on the part of the writers who participated in this presentation of a great array of important problems. This volume should be read by all practicing physicians and well-trained physical educators, as well as by school administrators, teaching bodies of the different school subjects, and by progressive lay members of all rural and urban communities.

J. A. Clement,
Professor of Education,
University of Illinois.

FABRICS AND CLOTHING. Sarah MacBride and Ellen McGowan. Macmillan Company. 225 pp. $1.00.

Fabrics and Clothing is a textbook for use in the teaching of fabrics in the upper elementary grades and the junior high school. It is written in a clear and simple style, and its content is set forth so as to enlist the interest of the reader. The authors give an excellent discussion of the origins of the different kinds of fabrics, how they are made, and the possibilities of design and color in fabrics. There is an excellent chapter on intelligent buying which gives the foundations which one must have if he is to buy satisfactorily. The interest of the reader in her personal appearance is enlisted and the effect of clothes upon herself and others is considered. The last chapters of the book are devoted to a study of fabrics commonly used in the home.

There are several chapters which are of interest to the teacher of physical education. The discussions of the wearing qualities and of the judging and testing of fabrics are excellent. Of interest also are the discussions of the types of material to be used for different purposes, the effect of the kind of material on the temperature of the body, and the laundering qualities of various kinds of fabrics.

Clare Small,
Professor of Physical Education,
University of Colorado, Boulder.

TEXTILES AND CLOTHING. Ellen McGowan and Charlotte A. Waite. Macmillan Company. 344 pp. $1.32.

The content of *Textiles and Clothing* is much the same as *Fabrics and Clothing* with a more detailed and technical account of textile origins and structure.

Clare Small,
Professor of Physical Education.
University of Colorado, Boulder.

DRAMATICS. Pearle Le Compte. A. S. Barnes and Company. 1931. 180 pp. $1.00.

Criticism is based upon the use of this book by those primarily interested in recreation, health and physical education.

The Foreword by Harold D. Meyer emphasizes wholesome use of leisure time and the coordination of processes of education through a careful organization. The Introduction by Harold A. Ehrensperger warns of intentional condensation. The reviewer

gave leisure time, gained a clearer understanding of new possibilities for the interweaving of many interests and finished the book in five hours. The "proof of any pudding is in the eating."

Pearle Le Compte voices a philosophy which has application in physical education as well as in dramatics. "Besides general dramatic and cultural values, a play is calculated to stimulate discussion, and any medium for conversation with a thread of intelligent thought behind it is a boon to American family and social life." So say we all of us. "In America, the amateur movement in dramatics thus far has been more concerned with stage carpentering, design, lighting, costuming—all on the spectacle side, to the neglect of the acting." Again, "Good equipment is desirable but not necessary for good creative work." This sounds familiarly like Dr. Goodwin Watson's "Philosophy of Physical Education" in the September issue of *Health and Physical Education*. Pearle Le Compte also suggests "Tell me what you laugh at and I will tell you what you are." "One cannot advertise goods he is not prepared to deliver." The instructor whose decisions do not carry across the baseball field will profit by the chapter on pitch, volume, quality and duration of voice.

Dramatics is a condensed guide for those who attempt festivals and dance recitals. The pantomime of such programs demands a play-producer's careful consideration of color, line, tempo and crescendo emphasis. The chapters with suggestions on organization of committees and conduct of rehearsals have many applications.

As the Introduction warned, Pearle Le Compte offers you a condensation of practical experience. For those who wish more, there is a bibliography for the direction of extensive reading on the "Why," "What," "How," and the "Where," of Dramatics.

Mary Effie Shambaugh,
Assistant Supervisor of Physical Education, University of California at Los Angeles, California.

THE ADMINISTRATION OF PHYSICAL EDUCATION. Jay B. Nash. A. S. Barnes & Co. 1931. 491 pp. $3.00.

When one reads the author's preface and introduction, then reads the book, and finally reviews the preliminary chapters, he is impressed with the concise, clear-cut, forceful manner with which objectives are set up for the book and met. No space is wasted with superfluous material, and the 491 pages are packed with facts, figures, forms, and maps which enable the reader to better understand the problems under discussion.

Part I deals with definitions; a brief discussion of the philosophy of education, and the increasing part physical education plays in it; the legal entanglements encountered in attempting to unify administration of school, park, and playground departments; and suggests ways and legal machinery whereby municipal and school authorities can conduct recreation activities harmoniously.

In Part II objectives are set up, and life is viewed from four levels of development: organic, neuromuscular, interpretive-cortical, and emotional-impulsive. "Oneness of mind and body and spirit become keynotes," and we read that "no education is worthy the name that does not have a contribution to all four levels."

Part III discusses the organization necessary in conducting a department of physical education. Federal, state, county, city, and institutional plans of organization are diagrammed and discussed. The chapter on "Physical Education Plant"—dealing with instructional units, service units, and administrative units of high, elementary, platoon, and rural schools, as well as the matter of supplies and standards used in allotting them—is worth the price of the book. Adequate time allotment for instructional and laboratory periods, in which classified activities are presented by the psychological rather than the logical method, is recommended. The author suggests that activities should be selected for

the protection and guidance of individuals on the various levels of development, and that children should be classified for the purpose of protection and securing maximum efficiency in teaching. The problems of leadership, both professional and lay, and their requirements are presented.

Routine administration is covered in Part IV. Office management, making reports, and keeping adequate records, together with the general principles underlying policy making, is first taken up followed by a treatise on inter-scholastic and intramural sports. The purpose of supervision is to improve instruction, and is an important phase of administration. Rating scales and general procedure are presented from the standpoint of modern school supervision. The reader is given a clear conception of who shall be admitted and graduated from teacher training institutions, and what constitutes a core curriculum in health and physical education for both undergraduates and graduates. The author brings out the modern point of view of having the department of health and physical education headed up by an individual who is thoroughly trained and capable of coordinating health service, health education, and physical activities into one unit. The book closes with some splendid suggestions on promotion of the profession, and a challenge to do further research in order to measure progress.

Dr. Nash has made a distinct contribution to the literature of our profession. He has been meticulous in acknowledging statements of others. He has provided a rich bibliography, together with problems and principles, at the end of each chapter, which help to make the book well adapted as a text. It is an outstanding book in the field of Organization and Administration of Physical Education, and will be especially helpful to administrators and supervisors.

Strong Hinman,
Supervisor of Health and Physical Education, Public Schools, Wichita, Kansas.

AMERICAN INDIAN DANCE STEPS. Bessie Evans and May G. Evans. A. S. Barnes & Co. 104 pp. $5.00.

In the average book of Indian dances and Indian music, one usually finds the superficial opinion of a casual observer, who has witnessed publicly or privately a modernized version of ancient rites and rituals, and who has translated the accompanying music or rhythms into harmonies suited to the public ear. In the book *American Indian Dance Steps* there is evidence of careful research in the elements of the dance and music of certain of the Pueblo tribes of New Mexico, and a suggestion by the authors that "while some phases of the dance are described as 'characteristics of the Indian,' it should be borne in mind by the reader that they are characteristics observed at least in the Pueblos mentioned. Since it is highly probable, however, that many of the characteristics noted are typical of Indian dance art in general, it is hoped that the present brief treatment of the subject, representing work in its initial stage, will prove suggestive to students wishing to make a more extended research in the future."

The authors state that the purely musical element of the Indian's composite art of dance and song has fared better at the hands of scholars than has the element of body movement. Melodies have been transcribed in as accurate a form as present musical notation permits, and a great body of pure, authentic Indian song has been preserved in permanent form.

The dance, however, meets with difficulties, one of which is the distrust with which the Indian views the white race, a distrust which is bred through fear of misinterpretation, and through lack of sympathy and understanding.

The Indian's own attitude toward dancing is one of remarkable earnestness, and as example they state that:

1. The Indian takes his dancing *disinterestedly*. He does not

dance to earn his living, or to win applause on the stage.

2. He takes his dancing *heroically*, and this even to the point of self-sacrifice for a principle.
3. He takes his dancing *responsibly*, every step, every tone, every drum-beat, every syllable, is rehearsed diligently lest there be a flaw of omission or commission in a ceremony designed to honor and propitiate, not offend, the spirit powers.
4. He takes his dancing *reverently*. For centuries, the white man has been reading reverently in the Psalms the admonition, "Let them praise his name in the dance"; but he has left it to primitive man to give heed.

It is stated that Indian dancing is reduced to a few basic movements (namely: the jump, hop, skip and tap) and following these movements, the authors give detailed descriptions of characteristic dance steps, followed by six complete dances: The Eagle Dance, War Dance, Sun Dance, Matachines, Yébichai Dance Fragment, and the Dog Dance, with the authentic music and songs which accompany them.

Each dance is beautifully illustrated in color, showing typical postures and costumes. These illustrations were painted by Poyeage, a San Ildefonso Indian.

The steps, dances and music are presented in a clear and precise manner, and the book will be valuable not only to those interested in the American Indian, and in authentic material of American Indian dances and songs, but to those who take pleasure in having a beautiful book in their library.

The book may be best summed up by the statement in the foreword by Mr. Frederick M. Hodge of the Museum of the American Indian, New York City. He says, ".....I recall how greatly I had wished that some of my dancing Zuñi Indian friends could have been present and that I could have heard their enthusiastic and generous *Hish hinina* 'Verily the same!' which echoes a deeper sense of appreciation than the words seem to picture."

Helen N. Smith,
University of Cincinnati.

FUNDAMENTALS OF HEALTH. T. Bruce Kirkpatrick and Alfred F. Huettner. Ginn & Company, 1931. 576 pp. $3.80.

This text, the result of the joint authorship of a biologist and a director of physical education, presents a point of view rather different from that of most texts.

The authors made a canvass of the topics relating to life in which students are primarily interested and on that basis have made their selection of subjects and determined upon the relative emphasis of each.

Naturally the biological and physiological aspects of health are treated extensively. It is gratifying to find such a fine chapter on "The Muscular System and Muscular Activities." It is probably the best that has yet appeared.

Viewing this text as a whole it is highly satisfactory for use by non-medical college students. Possibly it might be more acceptable if the treatment on genetics and human inheritance had been a little less technical, and if the subject of drugs, stimulants and narcotics had been dealt with more extensively.

The illustrations are in the main good. Some of the line drawings are not very finished, and there might be raised a question as to whether or not, for non-medical students, it is wise to include so prominently some of the abnormalities of development, such as those on page 415.

The topic of "Sex and Reproduction" presents a very sane attitude, however, and provides information of a type calculated to steer students past many of the dangerous aspects of this phase of life.

It is a pleasure to note and commend this text. It deserves very wide adoption.

G. B. Affleck,
International Y.M.C.A. College,
Springfield, Mass.

ELEMENTARY SCHOOL LIFE ACTIVITIES. Vol I, All School Activities. F. C. Borgeson. A. S. Barnes & Co. 150 pp. $1.00.

The well known and somewhat hackneyed phrase (extra-curricular activities) has given place to one of more significance in *Elementary School Life Activities* by F. C. Borgeson. The work is a report of the author's observations gained from years of experience in directing school life activities, supported by reports of present day practices in representative elementary schools throughout the country. These reports were secured by sending an inquiry blank to principals of two hundred cities known to represent not the *general,* but the *best* procedure in pupil participation in school life.

The work is published in two volumes of pocket manual size. Volume I will be of greatest value to principals, supervisors, and home room teachers, who are responsible for activities which include the whole school.

The following opinions are held by the writer concerning school life activities:

1. School life activities (extra curricular activities) are more significant educationally than are traditional activities.
2. School life activities taken collectively or individually more specifically meet the cardinal objectives of education than do traditional curricular activities —they are more closely related to the objectives.
3. School life activities must therefore be as scientifically planned as are the distinctly curricular activities.

There is a fund of material in which the reader will find not only inspiration but usable suggestions.

The chapter headings will give an idea of the material covered:

1. Definitions and Values
2. An Inquiry into Present Practice and Theory
3. Home Room Activities
4. School Management Activities
5. Drives and Campaigns
6. Assemblies and Special Day Celebrations
7. Character Growth Through School Life Activities

Appendix: Copy of inquiry blank.

As is so often true with a new idea introduced in educational procedure there would appear to be a possibility of over emphasis in this type of endeavor. It seems to the reviewer that the author might have stressed the fact that a great deal of care should be exercised in the selection of material so that the school is not cluttered with so many activities that none are brought to a satisfying completion. Projects should be satisfying both to the children and the school.

Considering the dearth of printed material in this field, the author has succeeded in compiling a very creditable bibliography.

The book will be of particular use to those administrators and advisers who are anxious to make their schools a vital part in the life of the child, but who are not clear as to the details of the organization of pupil activities.

Helen Gass, Assistant Supervisor, Elementary Physical Education, Long Beach City, Calif., Schools.

A SCORE CARD FOR EVALUATING PHYSICAL EDUCATION PROGRAMS FOR HIGH SCHOOL BOYS. California State Department of Education, Division of Health and Physical Education. Bulletin E-2, Sacramento, 1931. 45 pp. 25¢.

Under the expert guidance of Supervisor Neilson, California has produced a monumental piece of work in their two new score cards released this year. Bulletin E-2 for boys and bulletin E-3 for girls are probably the most complete and objective set of standards for all phases of the physical education program yet produced. In reality they are score books rather

than cards, each bulletin having forty-five pages of helpful material.

Beginning with an informative introduction and general instructions for scoring, the bulletins set up standards for instructional staff, facilities, organization, and activities of program and professional assistance. These large divisions are broken down to concrete objective small units so that any one wishing to know, for example, the desirable size of a handball court, the number of archery arrows needed for 150 students, or the relative value of the years in recency of professional training, can find an answer.

Evaluation of programs has long been an objective of the profession. Smaller score cards have been produced locally. Neilson has produced one applicable to an entire state, and possibly to a nation. Its bulk is at once its only drawback and the mark of its effectiveness. The huge task of examining every phase of a complete program has been undertaken and, large or small, this is complete and usable.

The authors of the bulletins, and contributions came to it from many stated sources, realize its imperfections. They believe it should be used voluntarily by schools to check their programs with the chief value being in the analysis of the detailed score rather than in the gross totals. Here as in no other publication, school administrators, teachers and supervisors of Health and Physical Education can find an enormous number of objective standards by which to judge the value and completeness of local programs.

D. Oberteuffer, Ph.D.
Supervisor of Health and Physical Education, State of Ohio.

HEALTHFUL LIVING—THE WHY AND HOW. S. E. Bilik, M.D. Charles Scribner's Sons. 261 pp. $2.50.

In his introductory chapter, the author points out the fact that leaders in the field of health education have been slow to capitalize on the widespread interest in health matters on the part of the general public which began about twenty-five years ago. He laments that the field has been exploited by faddists, quacks and cranks, but believes that they should be given credit for leading the way in what he terms the "Health Revolution."

A chapter on "Our Body" is written for the purpose of making clear the author's discussion in succeeding chapters. It is concise and free from technical terms.

In the discussion of "Exercise," due emphasis is put on the necessity of a thorough physical examination by a competent physician before commencing any type of a training routine. It is also pointed out that an exercise program should be planned with reference to age, sex, physical condition, and occupation of the individual. The author believes that exercise need not necessarily be enjoyable for it to be productive of beneficial results, and that "setting-up exercises are invaluable in the building of healthy, vigorous bodies."

He is emphatic in his declaration that strenuous athletic competition is not an essential phase of a health building program. Especially timely, in view of the forthcoming Olympic Games, are his views on athletic competition for women.

He points out that "physical training suitable for men becomes physical straining injurious to women."

Additional chapter headings are "Diet," "Miscellaneous Subjects," "More About Girth Control," "Choosing Your Physician," "Common Ailments," and "First Aid Hints."

The material is presented in breezy, direct and forceful style. It should find wide acceptance among non-technical readers and can well be recommended for the library shelf in junior and senior high schools.

P. B. Samson,
Professor of Physical Education, Michigan State Normal College.

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AMERICAN PHYSICAL EDUCATION ASSOCIATION

Box 362, Ann Arbor, Mich.

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